

APPENDIXES

Appendixes are provided electronically for this *Draft Environmental Impact Statement*. The electronic files are available from the park's Colorado River Management Plan Internet website at <<http://www.nps.gov/grca/crmp>>, along with electronic files for the entire *Draft Environmental Impact Statement*. The Appendixes are also available on Compact Disk, which can be requested by sending an e-mail message with your name and mailing address to <grca_crmp@nps.gov>, or by calling 928-779-6279.

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APPENDIX A: LAWS

| Laws, Policies, and Regulations Relevant to the Colorado River Management Plan | |
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| Law | Record |
| The National Park Service Organic Act of 1916 | 16 U.S.C. 1 et seq. |
| National Environmental Policy Act of 1969 (NEPA) | 42 U.S.C. 4321 et seq. |
| Federal Land Policy and Management Act of 1976 (FLPMA) | 43 U.S.C. 1701 et seq. |
| CEQ general regulations implementing National Environmental Policy Act of 1978 | 40 CFR Parts 1500–1508 |
| Department of Interior's (DOI) Implementing Procedures and proposed revisions (<i>Federal Register</i> , August 28, 2000) | 516 Director's Manual 1–7 |
| National Park Service General Authorities Act of 1970 and 1978 | 16 U.S.C. 1a-1 |
| National Historic Preservation Act of 1966 (NHPA) and regulations implementing NHPA | 16 U.S.C. 470 et seq. 36 CFR Part 800 as amended |
| Antiquities Act of 1906 | 16 U.S.C. 431 et seq. |
| Clean Water Act of 1948 | 33 U.S.C. 1251 et seq. |
| Clean Air Act of 1955 | 42 U.S.C. 7401 et seq. |
| The Wilderness Act of 1964 | Public Law 88-577 |
| Wild and Scenic Rivers Act of 1968 | U.S.C. 1271 et seq. |
| Rights of Way on Tribal Trust Land Act of 1968 | 25 CFR Part 169 |
| Occupational Safety and Health Act of 1970 | 29 U.S.C. 651 et seq. |
| Airborne Hunting Act of 1971, as amended 1972 | 16 U.S.C. § 742j-1 |
| Water Pollution Control Act Amendments of 1972 | 33 U.S.C. 1251 |
| Noise Control Act of 1972, as amended | 42 U.S.C. 4901 et seq. |
| Endangered Species Act of 1973 | 16 U.S.C. 1531 et seq. |
| Federal Water Project Recreation Act of 1965, as amended 1974 and 1976 | U.S.C. 4601-12 et seq. |
| Special Recreation Permits and Special Recreation Permit Fees Act of 1974 | 36 CFR 71.10 |
| Safe Drinking Water Act of 1974 | 42 U.S.C. s/s 300f et seq. |
| Grand Canyon National Park: Aircraft or helicopter regulation within enlarged boundaries; procedure for promulgation of administrative rules and regulations of 1975 | 16 U.S.C. 228 |
| American Indian Religious Freedom Act of 1978 | 42 U.S.C. 1996 et seq. |
| Archaeological Resources Protection Act, as amended of 1979 (ARPA) | 16 U.S.C. 470aa et seq. |
| Aircraft Overflights in National Parks Act of 1987 | Public Law 100-91 |
| Federal Cave Resources Protection Act of 1988 | Public Law 100-691 |
| Native American Graves Protection and Repatriation Act of 1990 | 25 U.S.C. 3001 |
| Pollution Prevention Act of 1990 | 42 U.S.C. 13101 et seq. |
| Hualapai Constitution, Amended 1991 | Public Law 93-560 |

| Laws, Policies, and Regulations Relevant to the Colorado River Management Plan | |
|--|---|
| Law | Record |
| American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act of 1997 | Secretarial Order 3206 (June 5, 1997) |
| National Parks Omnibus Management Act of 1998 | U.S.C. 5901 et seq. |
| National Parks Air Tour Management Act of 2000 | Public Law 106-181 |
| Migratory Bird Treaty Act of 2001 (Migratory Bird Guidance) of 2001 | 16 U.S.C. 703-711 |
| Planning, Acquisition, and Management of Federal Space Act of 1970 | Executive Order 11512 |
| Protection and Enhancement of the Cultural Environment Act of 1971 | Executive Order 11593 |
| Tribal Law and Order Code of 1975 | Hualapai Tribal Council Resolution 72-72 |
| Floodplain Management Act of 1977 | Executive Order 11988 |
| Protection of Wetlands Act of 1977 | Executive Order 11990 |
| Exotic Organisms Act of 1977 | Executive Order 11987 |
| Federal Compliance with Pollution Control Standards Act of 1978 | Executive Order 12088 |
| Regulatory Planning and Review Act of 1993 | Executive Order 12866 |
| Environmental Justice Act of 1994 | Executive Order 12898 |
| Indian Sacred Sites Act of 1996 | Executive Order 13007 |
| Invasive Species Act of 1999 | Executive Order 13112 |
| Consultation and Coordination with Indian Tribal Governments Act of 2000 | Executive Order 13175 |
| Government to Government Relations with Native American Tribal Governments Memorandum of 1994 | Memorandum for the Heads of Executive Department and Agencies (signed by President Clinton on April 29, 1994) |
| Hualapai Environmental Review Code of 1997 | Hualapai Tribal Council Resolution 50-97 |
| Park Planning | Director's Order #2 |
| Law Enforcement Program | Director's Order #9 |
| Environmental Impact Analysis | Director's Order #12 |
| Cultural Resources Management | Director's Order #28 |
| Wilderness Preservation and Management | Director's Order #41 |
| Soundscape Preservation and Noise Management | Director's Order #47 |
| Concessions Management | Director's Order #48 |
| Special Park Uses | Director's Order #53 |
| Natural Resources Protection | Director's Order #77 |

APPENDIX B: PUBLIC SCOPING SUMMARY

ERRATA SHEET

The June 2003 Summary Public Scoping Issue Analysis contained an error on pages 1 and 2. The meeting held in Peach Springs, Arizona on September 3, 2002, was not a public scoping meeting as stated, but a town meeting held at the request of the Hualapai Tribe. This meeting was part of tribal consultation for the CRMP EIS. Therefore, there were seven public scoping meetings, rather than eight as stated.



Summary

Public Scoping Issue Analysis
Grand Canyon National Park
Colorado River Management Plan and
Environmental Impact Statement

Prepared for

Grand Canyon National Park
Grand Canyon, Arizona

By

SWCA Environmental Consultants
June 2003

SWCA
ENVIRONMENTAL CONSULTANTS

Public Scoping Issue Analysis Summary
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INTRODUCTION

On June 13, 2002, the National Park Service (NPS) issued a Notice of Intent (NOI) in the *Federal Register* for the preparation of an Environmental Impact Statement (EIS) for the Colorado River Management Plan (CRMP). As stated in the NOI, "The purpose of this EIS/CRMP is to update management guidelines for the Colorado River corridor through Grand Canyon National Park." During a public scoping period from June 13 to November 1, 2002, the NPS sought public input to reaffirm previously identified agency and public issues and to identify any new public issues and concerns. Previously identified agency and public issues were compiled in the *Summary of Public Comment from the 1997 Colorado River Management Plan Scoping Process, April 1998*, which is posted on Grand Canyon National Park's (GRCA's) CRMP Internet site (www.nps.gov/grca/crmp). Information about the 2002 scoping process was disseminated to the public, and input was solicited, through GRCA's CRMP Internet site, press releases, mailings, and public meetings.

Public Scoping

Scoping is required for National Environmental Policy Act (NEPA) compliance documents, including EISs, to determine the scope of the document; that is, what will be covered and in what detail. The scoping process must be open to the public; state, local, and tribal governments; and affected federal agencies. The objectives of scoping are:

- Involve as many interested parties as possible in the environmental review process.
- Provide clear, easily understood, factual information to potentially affected parties.
- Provide meaningful and timely opportunities for public input.
- Identify, consider, and evaluate significant issues raised by interested parties to assist in the preparation of the Grand Canyon CRMP/EIS.
- Identify and eliminate from detailed study the issues that are not significant.
- Consider public comments throughout the decision-making and review process.

Public Meetings

As part of the 2002 scoping process for the CRMP/EIS, GRCA retained a consultant, The Mary Orton Company, to help organize and manage a series of public meetings. More than 1,000 people attended a total of eight such meetings, which were held on the dates and in the communities listed below.

| | |
|-------------------|--|
| August 1, 2002 | Denver, Colorado |
| August 6, 2002 | Sandy, Utah (suburb of Salt Lake City) |
| August 8, 2002 | Flagstaff, Arizona |
| August 13, 2002 | Las Vegas, Nevada |
| August 15, 2002 | Mesa, Arizona (suburb of Phoenix) |
| September 3, 2002 | Peach Springs, Arizona |

September 30, 2002 Towson, Maryland (suburb of Baltimore)
October 2, 2002 Oakland, California

The meetings were structured as open houses. Information about the CRMP/EIS process was presented through posters, handouts, and a large map of the project area. National Park Service personnel were available to answer questions, and rooms were provided for facilitator-led discussion groups. Attendees were invited to write comments on flipchart tearsheets and the map, provide comments orally to a court reporter, and submit written comments. A form and a permit-related questionnaire were provided for that purpose. Comments made during the discussion groups were recorded by the facilitators on flipchart tearsheets.

PUBLIC INPUT TO THE GRAND CANYON CRMP/EIS PROCESS

Written public comments were submitted to GRCA by e-mail, U.S. mail, and hand delivery, as well as at the open house meetings. Organization and analysis of the submissions were completed with the assistance of SWCA Environmental Consultants, a firm retained by GRCA to help develop the EIS. The submissions were organized into ten categories to facilitate handling, analysis, and archival storage. These categories are listed below.

| | |
|--------------------------|---|
| Letter (L) | Boater's Questionnaire (B) |
| Form Letter (FL) | Open House Flipchart Tearsheets (T) |
| E-Mail (E) | Discussion Group Flipchart Tearsheets (D) |
| Form (F) | Map (M) |
| Permit Questionnaire (P) | Recorded Transcript (R) |

In all, 13,770 submissions were received, cataloged, and reviewed.

REVIEW AND EVALUATION OF SCOPING COMMENTS

Members of the CRMP/EIS team read through every submission. They identified specific comments within each submission and coded them according to criteria developed for the process. When the initial review process was completed, a total of 55,165 comments were identified within the 13,770 submissions. Comments were screened again to summarize observations, opinions, concerns, and recommendations. This process resulted in the summary table of comments appended to this document. Almost every major comment received in 1997 (see *Summary of Public Comment from the 1997 Colorado River Management Plan Scoping Process, April 1998*) was reiterated in 2002, plus several more. Given the number of comments received in 2002 (over 55,000), the variations in detail are boundless. The major issues stand out, however, and are consistent with those raised in 1997. They are encapsulated in the statements provided below. Many very detailed proposals and discussions were received, several greater than 50 pages. It was not possible to adequately summarize every specific suggestion offered in some of those longer submissions; however, they have been and will continue to be carefully considered in developing the plan and EIS.

Major Issues Raised in the 2002 Scoping Comments

Access and Visitor Services

- The NPS should not implement any management action that would reduce opportunities for the public to experience a Grand Canyon river trip. A wide range of river running opportunities should be provided (including educational trips) for people with different skill levels, time

constraints, levels of income, physical needs, and for those who desire different kinds of experiences.

- The NPS should provide more equitable access for different kinds of river use (see issues related to allocation, permits, and level of use).
- Repeat use should not be limited for non-commercial trips. Experience is gained through repeat use, and having experienced users on trips adds to safety and enhances the experience.
- Non-commercial trips should be allowed to use paid guides and/or rental services.
- Non-commercial trips should not be allowed to use paid guides and/or rental services.
- Infrastructure should be improved, both physical facilities on the river and technological communications with the public (web communication with users, e.g., calendar of launches, research results). The ramp at Lees Ferry should be improved; facilities at Phantom Ranch should be increased; facilities like Phantom Ranch should be added at other locations (but kept unobtrusive); a channel should be dredged in Lower Granite Gorge to restore more natural river flow.
- Additional riverside facilities should not be permitted.

Motors and Aircraft Use

- Use of motorized craft should be reduced or eliminated because it is incompatible with the wild, backcountry character of the river. Motorized craft disturb natural quiet, impair air quality, and/or detract from the quality of what should be a primitive recreational experience. The non-motorized season should be extended and/or redefined (several suggestions). Quieter motor technology should be encouraged or required. Personal watercraft (jet skis) should not be allowed upstream of the Grand Wash Cliffs.
- Use of motorized craft should not be reduced or eliminated because it allows access for the maximum number of people, including 1) special populations (e.g., disabled, elderly, physically unfit), 2) people too inexperienced to mount a private trip, and 3) people who cannot afford the time or cost of a non-motorized trip. Motors allow convenient short trips and reduce congestion on the river. Current motor technology is quiet, does not contribute to noise or air pollution, and does not detract from visitor enjoyment.
- Helicopters (including helicopter exchanges at Whitmore) should be eliminated from within Grand Canyon except for emergencies. They are incompatible with the wild, backcountry character of Grand Canyon, disturb natural quiet, impair air quality, and detract from the quality of the recreational experience. They introduce mechanized, frenetic, stress-inducing activity, which many people take Colorado River trips to avoid. Helicopter exchanges allow short, hurried trips that are inappropriate for Grand Canyon.
- Helicopter exchanges should not be eliminated because they increase access (particularly for special populations) by providing shorter trips and a way to get in and out of the Canyon without having to hike, ride a mule, or traverse long, primitive roads (especially onerous during hot months). Reintroducing mules at Whitmore would cause different environmental impacts, including odor and flies. Helicopter use provides essential income for the Hualapai Tribe, and its elimination without commensurate compensation would result in undue economic impact on the Tribe.

Allocation and the Non-Commercial Permit System

- The current allocation between commercial and non-commercial use is unfair and should be made equitable (a 50/50 split was commonly recommended), or non-commercial use should have the larger allocation. The long wait by non-commercial users and limitations on repeat use cannot be justified while commercial passengers can go on short notice and as often as they want. It is also unfair that guides are not counted in the commercial allocation. Suggestions for remedy include increasing the non-commercial allocation by decreasing commercial use (various levels recommended) or by increasing overall use (various levels recommended). Guides should be included in the commercial allocation.
- The current allocation is appropriate and should be maintained, or commercial use should have an even larger allocation. Compared to non-commercial use, outfitters serve far more potential users, allow greater public access, offer more and better services (e.g., expertise, safety, education), and provide better stewardship of the Canyon and its resources. Commercial guides act as an “enforcement” arm for the NPS, while non-commercial users are less likely to obey the rules. Respondents taking this position often recommend that non-commercial use should be further restricted, eliminated, or better regulated by the NPS. Non-commercial permit holders should meet certain minimum qualifications (e.g., previous rafting experience, knowledge of Grand Canyon, demonstrated knowledge of regulations).
- Commercial use should be reduced, eliminated, or better regulated (especially fees charged customers) because it exploits the Canyon for profit, inappropriately dominating use of a public asset to financially benefit a handful of private companies. Small companies should replace large ones; outfitters should be phased out as their contracts expire or they sell; Incidental Business Permits should be allowed to supplement or replace the current concession system.
- Allocation between commercial and non-commercial use should be abandoned in favor of a “common pool” system so that all interested people have an equal chance to run the river, whether they want the assistance of an outfitter or not. Several suggestions were offered about how to implement such a system.
- A common pool system should not be implemented because it would be unmanageable for commercial outfitters, preventing them from providing essential services. Under a common pool system, applicants who want a commercial trip might swamp non-commercial applicants, further reducing their ability to get on the river.
- The current non-commercial permit system is unfair, cumbersome, costly, and subject to many kinds of abuses. The waiting list is far too long and should be reduced or eliminated. Those currently on the list, especially those who have already waited many years, should not be penalized if the system is changed. Many suggestions, some very detailed, were offered for revamping the current system to eliminate or reduce these problems.
- The permit system should be replaced by a lottery or reservation system. Several variations were offered, including weighted lottery or reservation systems and hybrid systems incorporating elements from the existing system.
- A lottery should not be instituted because some people would never win a permit.

Level of Use/Crowding, Trip Length, Group Size

- Overall use should be increased to provide more access, particularly for non-commercial users. Crowding can be avoided by extending the primary season into spring and fall; increasing winter use; evening out launches over the week, season, or year; or by scheduling use of campsites and attraction sites.

- Existing use levels should not be increased because crowding and impacts on the environment would be a problem. Scheduling use of campsites and attraction sites should be avoided because it would be unworkable and would detract from the spontaneity of a backcountry river experience. Also, use levels should be decreased to reduce excessive crowding and/or impact on cultural and natural resources.
- Trip length maximums should be decreased to allow more access for others.
- Trip length maximums should be increased to provide opportunities for a richer experience (e.g., slower pace, more hiking). Trip length minimums should be increased to preclude quick, hurried trips, particularly above Diamond Creek.
- Group size maximum should be decreased to provide a truer backcountry experience, increase opportunities for solitude, reduce noise and social interactions, reduce crowding, and reduce impact on resources.
- The group size maximum is fine or should be increased to increase access opportunities.

Resource Protection, Tribal Issues, NPS Regulations

- Protection of natural and cultural resources should be the NPS's first priority. The NPS should use an adaptive management approach, improve monitoring, and increase/facilitate research activities to better conserve and restore natural conditions.
- NPS should eliminate adaptive management, reduce the number of research trips, and place more restrictions on research activities (e.g., who can participate, when they can launch, type of craft used, where they can camp).
- Natural resource concerns expressed in comments include protection of wildlife, preservation/restoration of endangered or rare native species (notably native fish), reintroduction of extirpated native species, and eradication of non-native species (notably tamarisk). Excessive social trailing is a problem; trails should be established and maintained where erosion, trampling, and multiple trails are evident. Loss of camping beaches should be addressed through Glen Canyon Dam operations, artificial infusion of sand below the dam, and/or by removal of invasive vegetation. Impacts on air and water quality due to motor use should be addressed.
- Non-native trout should be conserved for angling opportunities. Trails should not be established and maintained; the NPS should use a minimum tool philosophy, keeping management intervention to a minimum. Use of herbicides to reduce invasive vegetation should be reconsidered.
- Specific cultural resource concerns include damage to archaeological sites, with suggestions for restricting access to some sites.
- Access to archaeological sites should not be restricted.
- Access to Native American sacred sites should be prohibited and access to adjacent tribal lands restricted to specified areas under specified conditions. The NPS should better enforce these regulations and should coordinate and collaborate with tribes to manage river use; support tribal needs (particularly at the Diamond Creek take-out); provide more opportunities for tribal participation in river use upstream of Diamond Creek; and generally respect tribal sovereignty. Tribal use of the Grand Canyon should be held to the same standard as non-tribal use.
- NPS personnel should step up enforcement, increase river patrols, restrict alcohol use, extend drug testing, and prohibit nudity to better protect the environment, increase safety, and reduce unruly behavior that detracts from the quality of the river experience for others. They should provide more information about regulations, proper river etiquette, and the Canyon (geology/

biology/history) before launch, at launch, and on-river (e.g., join all trips or visit camps more often). They should make better use of the Internet, particularly in regard to launch schedules, research activity, and permit cancellations.

- The NPS should reduce their presence on the river, be less confrontational, never visit camps, and never carry firearms. NPS should eliminate drug testing for commercial guides.

SCOPE OF THE CRMP/EIS

The purpose of the CRMP is to provide direction for resource preservation and visitor experience as they relate to visitor use of the Colorado River corridor. According to the Notice of Intent published in the *Federal Register* on June 13, 2002, the CRMP/EIS will include, but not be limited to:

- appropriate levels of visitor use consistent with natural and cultural resource protection and preservation mandates;
- allocation of use between commercial and non-commercial groups;
- the permitting system for non-commercial users;
- the level of motorized versus non-motorized raft use;
- the range of services and opportunities provided to the public; and
- the continued use of helicopters to transport river passengers to and from the Colorado River near Whitmore Wash (in consultation with the Hualapai Tribe and other appropriate parties).

Issues Raised in Public Scoping Determined to Fall Outside the Scope of the CRMP/EIS

Some issues that were raised during public scoping are outside the scope of the CRMP/EIS because 1) they do not directly address management of visitor use; 2) they are the subject of separate planning processes; and/or 3) they are beyond GRCA's management authority. Comments included in this group include positions both for and against the following:

- Decommissioning or regulating Glen Canyon Dam.
- Designating the river corridor as a Wilderness and/or as a Wild and Scenic River.
- Eliminating overflights.

Park boundary issues also fall within this group.

Another set of issues raised by the public are outside the scope of the CRMP/EIS process because they concern activities that are administrative in nature. These comments include the following:

- A specific allocation should be established for GRCA administrative use, and that allocation should be included in a total user-day cap. This suggestion is considered out of scope because management-related administrative use enables GRCA personnel to fulfill their mandated responsibilities. The level and timing of NPS presence on the River, therefore, must remain flexible. GRCA will continue to permit administrative activities based on resource protection, safety, and information needs with appropriate restrictions and an approval process. Uses such as education, however, are subject to consideration in the CRMP/EIS.
- Several comments address detailed operating requirements for both commercial and non-commercial use. Included in this category are specific suggestions for managing repeat use, private trip cancellations, launch schedules, sanitary waste disposal, fee structures, etc. These comments are outside the scope of the CRMP/EIS because they concern specific measures that

may be subject to change based upon new information or improved practices. As such, they more properly relate to operating requirements, which are detailed instructions implementing CRMP guidance. Operating requirements may be changed administratively as long as they are consistent with CRMP guidelines. In contrast, the CRMP is intended to provide overall guidance for the management of recreational use of the Colorado River corridor in the Park. Changes to the CRMP would require a NEPA document and a major planning effort.

Lastly, elimination of both commercial and private river uses of the river was recommended during public scoping. Neither suggestion will be considered in the CRMP/EIS because GRCA has determined that some level of commercial and private river operations are necessary and appropriate to meet GRCA General Management Plan goals.

Summary of the 2002 Public Scoping Comments

ACCESS

- A broad cross section of the population should have access to the river. Access should not be limited any more than necessary to protect resources.
- Increase access for special populations (disabled, elderly, juveniles, low-income).
- Ensure access for Native Americans with a traditional affiliation with Grand Canyon.
- Prioritize or restrict access to protect resources.
- Allow access only for U.S. citizens.
- Repeat use should be restricted because demand exceeds supply. Multiple suggestions were offered for restrictions (number of trips per time unit).
- Restrictions on repeat use should be equitable for both non-commercial and commercial users.
- Repeat use should not be limited.

ADMINISTRATIVE USE & NPS MANAGEMENT

- Current river management is satisfactory.
- The Park should receive more funding to better manage recreation and resources.
- NPS should base management decisions on scientific research (e.g., evaluate motor-use impacts on resources, conduct carrying capacity study).
- NPS should use minimum tool criteria when managing the river.
- River and backcountry management should be coordinated to prevent campsite conflicts between river runners and hikers.
- NPS patrols for conformance to regulations should remain the same or be increased; more effort should be made to enforce regulations.
- NPS patrols negatively affect visitor experience; should be reduced; should be eliminated.
- Administrative use trips (including educational trips) should be counted within overall use limits and the schedule of trips made public. Such trips should have specific allocations.
- Non-working NPS staff and non-researchers on NPS/research trips and educational trips under the guise of administrative use are an abuse; they should use outfitters.
- Expand drug testing among all river users.
- Eliminate drug testing for commercial guides.

- Restrict and/or prohibit alcohol use, smoking, and nudity. Rowdy behavior is offensive to other river users and impairs their river experience.
- Non-commercial use should be better regulated (e.g., more stringent qualifications, including licensing of trip leaders; more in-depth orientation for trip participants).
- Required qualifications for commercial guides should be increased.
- Some outfitters abuse their privilege by charging excessive rates, making excessive profits, and providing luxurious services inappropriate for a backcountry experience.
- NPS should increase activities to instruct all users about Canyon resource protection, river etiquette, and regulations (e.g., more guide training, better orientation at Lees Ferry, more camp talks, accompany trips).
- NPS should offer a wider variety of educational opportunities to river users (e.g. signage, interpreters, website).

ALLOCATION

- Base allocation on demand; conduct a demand study.
- Maintain current commercial/non-commercial allocation. It works well; reflects relative demand.
- Make the commercial and non-commercial allocations equitable (suggestions: 50/50 split; 40/40 split with 20% administrative use). Current allocation is unfair to non-commercial users, forcing applicants to wait many years while all commercial users have a short wait. Current allocation does not reflect large and growing demand by those who most value river running (devote the most time, effort, and resources to it).
- Give larger allocation to non-commercial use than to commercial use (various percentages suggested).
- Increase non-commercial allocation but do not decrease commercial user days (i.e., increase total user days).
- Increase non-commercial allocation by decreasing commercial user days. Some suggested eliminating commercial use altogether (various phase-out, buy-out options suggested) because it is inappropriate exploitation of a public resource for the financial benefit of a few entrepreneurs.
- Reallocate commercial motorized use to non-commercial, non-motorized use.

ALLOCATION (CONT.)

- Increase commercial allocation. Outfitters provide more access and services (see also Visitor Services section) for the general public. Some suggested decreasing or eliminating non-commercial use altogether, primarily because private parties are less likely to care for the environment, abide by regulations, or cooperate with other river users.
- Transfer some commercial user days to educational uses.
- Commercial crews should be counted within the commercial allocation.
- Ensure that all unused user days are reallocated within the same sector or to the other sector.
- Eliminate allocations; replace with a common pool system. Multiple suggestions were offered for how to implement such a system.
- Do not consider a common pool (e.g., would group strangers on a private trip, make planning difficult for commercial outfitters currently doing business in the Canyon, commercial market would swamp pool further reducing non-commercial access).

COST

- Commercial trips should include more affordable options; high costs limit access to the wealthy.
- Commercial rates are not excessive; they do not limit access.
- Maintain current non-commercial fee structure. It works well.
- The current non-commercial fee system is unfair, unaccountable, and confusing and should be changed (multiple suggestions offered).
- Non-commercial fees are too high and should be decreased.
- Non-commercial and commercial "fees" should be equivalent.
- Increase current non-commercial fees to discourage non-serious applicants and reduce wait list.
- Change or eliminate the Colorado River Fund; the fee demo.
- Park needs to be more accountable for what is done with fee income. Multiple suggestions were offered for how it should be spent, including subsidies for special populations, research, recovery of native species, Park maintenance, more NPS presence on river, buy-out of outfitters for reallocation to non-commercial use.

LEVEL OF USE

- Instead of "user days," manage use by launches and/or number of people.
- Continue "user days" system to measure and limit use.
- Maintain the current level of use. There are no apparent negative impacts.

- Reduce the current level of use to reduce negative impacts.
- Eliminate all use until native habitats can be restored.
- Increase the current level of use to allow greater access (particularly for non-commercial use); confine increase to the secondary season; consider making the river corridor a high use zone.
- Do not increase the current level if it will degrade resources and quality of visitor experience.
- Mitigate impacts rather than restrict use.
- Reassess the river's carrying capacity (crowding, impacts to resources).
- Crowding is a problem, especially at attraction sites; multiple suggestions were offered for how to reduce crowding and encounters with others using trip scheduling, trip length, levels of use, launch dates.
- Crowding is not a problem; crowding at attraction sites is not a problem.
- Fewer and smaller beaches reduce carrying capacity, increase crowding; increase the number and size of beaches to increase access.

MOTORS

- Allow motor use to continue at existing levels or increase. Motorized trips allow more people to experience the river because of shorter trips and larger group sizes, allow access for a broader cross-section of the population (e.g. disabled, elderly, juveniles), reduce crowding by allowing faster trips and varying speed, reduce contact time with other groups, and afford a higher level of safety to all river users.
- Motorized trips result in an acceptable level of environmental impact; noise levels are low because of 4-stroke motors; air pollution is not a problem.
- Eliminating motors would increase hiking and associated problems.
- Eliminate/phase out or reduce motor use. It produces air, noise, and water pollution and promotes fast, hurried trips, violating the natural sound, pace, and tranquility that should characterize a river experience. Motors are incompatible with wilderness.
- Motorized trips negatively affect non-motorized trips.
- All non-commercial trips should be non-motorized.
- Extend and/or reschedule the no-motor period (multiple suggestions for duration and timing).
- Ensure quiet or non-polluting motor technology; offer incentives (user days, fee reduction) to commercial operators who incorporate low-noise/pollution motor technology.
- Environmental effects of motors cannot be mitigated through technology.
- No personal watercraft (jet skis) should be allowed upstream of Grand Wash Cliffs.

AIRCRAFT

- Keep helicopter exchanges. They increase access by allowing less expensive, more convenient shorter trips; allow access for those who cannot, should not, or who would rather not hike; add another adventurous element to the river experience; eliminate long, hot, dusty rides over primitive roads; permit quick trips between airports and the Canyon.
- Helicopter exchanges at Whitmore reduce the load on take-out facilities at Diamond Creek and provide essential income for the Hualapai Tribe.
- Helicopter exchanges do not impact the wilderness experience. They are confined to a small area and operate for only short periods and at times when few other trips are in the vicinity.
- Decrease or eliminate helicopter use except for emergencies. Helicopters are highly intrusive on the natural quiet and splendor of the Grand Canyon backcountry. They introduce the noisy, mechanized, rushed attributes of the urban world that people come to the Inner Canyon to avoid. They detract from the quality of the river experience for others.
- Ending a river trip by a helicopter fly-out is abrupt, shocking, and inappropriate.
- Helicopter exchanges exist mainly to financially benefit outfitters by breaking up what should be single trips into multiple short trips that are profitable and easy to market.
- Substitute less intrusive modes of transport at Whitmore (e.g., mules/hiking/ airship).
- Mules should not be used at Whitmore; they create unsanitary conditions, foul odors, and flies. The trail is too difficult and hot in the summer to be hiked safely. The road from the trailhead is long, rough, and hard on vehicles and passengers.
- Require quieter helicopters.
- The heavy use of helicopters below Diamond Creek is inappropriate and offensive.

NEPA / PLANNING PROCESS

- The CRMP should be based on ecosystem management.
- The CRMP should incorporate adaptive management to allow future flexibility; provide for an ongoing advisory committee (e.g., similar to the AMWG); provide for frequent review and adjustment of Plan.
- The scope of the CRMP should include tributaries.
- Increase public participation in the CRMP/EIS process beyond the local region; include stakeholders in planning; make relevant scientific information available to public.
- Open house forum at public scoping meeting was an improvement over past public scoping methods. Open house was enjoyable.

PERMITS

- Maintain the current permit system; it is adequate.
- The current permit process is discouraging, complicated, inequitable, and the waiting time is far too long.
- The current permit system is rife with abuse (e.g., a small number of people take advantage of the system to make frequent repeat trips; some names are just placeholders, cancellations are excessive).
- The permit system should be simplified and made fair/equitable. Multiple, detailed suggestions were offered for modifying the current permit system (e.g., make permits transferable, allow more repeat use, provide more equal access among all non-commercial users, institute comparable wait times for commercial and non-commercial users).
- The waiting list should be made shorter (multiple suggestions offered).
- Transition to a different system other than the wait list should give priority to those already on the wait list.
- Replace the existing permit system with an auction.
- Replace the existing permit system with a lottery (multiple variations suggested).
- Do not consider a lottery (some people will never win a trip).
- Institute a reservation-based system (multiple variations suggested).
- Institute a hybrid permit system (multiple variations suggested).

RESOURCES

- Protection of ecological and cultural resources should be NPS's first management priority.
- Resources should be monitored for impacts.
- NPS should consider closing areas experiencing excessive impacts.
- Noise is a problem (large, motorized rafts; helicopters).
- The impact on air quality by motorized rafts is a problem.
- Social trailing is a problem and should be reduced; NPS should mark and maintain trails.
- NPS should modify terrain (e.g., do trail work) only where habitat preservation is necessary.
- Vegetation should be protected, including in the old high water zone and side canyons.
- Wildlife (e.g., bighorn sheep, condors) should be protected. River users chasing and catching wildlife is a concern.
- Visitor impacts on beaches are a problem (e.g., litter, urine, erosion).
- Beaches show little evidence of visitor impact.
- Restore beaches by sediment infusion, stabilization, reduction of encroaching vegetation.
- Near-river springs and seeps are valuable resources and should be protected.

RESOURCES (CONT.)

- Tributaries are an exceptional resource, should be managed and protected from visitor impact. Pollution from chemicals (sunscreen, shampoo, etc.) and human waste may be a problem.
- Visitor use of tributaries may increase native fish food supply by stirring up substrata.
- Protect, restore endangered species, including native fish (e.g., humpback chub, razorback sucker, Colorado pikeminnow).
- Re-introduce extirpated species, such as the otter and muskrat.
- Take management action to eliminate or reduce non-native species (particularly tamarisk); find means other than herbicides to control non-native plants.
- Keep species that have adapted to the dam-altered river (e.g., trout).
- Cultural resources, sacred sites, Indian lands are valuable and should be protected; install unobtrusive signs about site protection.
- Continue to allow public access to cultural resources.
- Close cultural sites if they are being impacted.
- Protect natural visual quality. Reduce trash; keep Canyon clean.
- Protect water quality.
- Maintain or increase scientific study on the river, increase communication of research results with public; allow increased motor use to facilitate research; simplify research permitting process, use consultants as much as possible.
- Be more stringent in determining which research projects are allowed; reduce the number of research trips; make more use of volunteers in the river running community; require research trips to camp at small campsites.
- Several suggestions were offered for resource research, monitoring, and management (e.g., study impact of group size, increased levels of use).

SCHEDULING

- Use the computer simulator to schedule use.
- Several suggestions were offered for redistributing launches (daily, weekly, seasonally, evenly over a year) to achieve fair scheduling for commercial and non-commercial trips, reduce crowding, allow more trips.
- Use shoulder seasons and/or winter season to increase use (commercial and/or non-commercial) or better manage existing use.
- Do not extend commercial use into winter months.
- Offer incentives for off-season use.
- Assign campsites, assign all or some attraction site stops to reduce crowding and/or increase access; require some shared use of campsites at pinch points.

- Do not assign campsites or attraction site stops. That would remove spontaneity, reduce the quality of the river experience, and may not be possible to achieve.
- Continue to allow layovers. They allow a slower-paced trip with more opportunities for solitude, quiet, and a chance to explore more of the Canyon.
- Reduce/eliminate layovers, particularly during the summer and at high-use camps. That would reduce crowding and conflict between trips.
- Reduce/eliminate all exchanges. They increase crowding above Phantom and promote quick, more superficial trips.
- Maintain or increase exchanges to provide a wide range of trip experiences and access for more people.
- Each exchange should be counted as two user days; each exchange should be counted as one user day.

TRIBAL ISSUES

- Respect tribal concerns and authority regarding river management.
- Allow tribes (specifically the Hualapai) to have a concession at Lees Ferry; allow the Hualapai Tribe to operate a concession from Lees Ferry; facilitate hiring of Native American guides; coordinate with tribes for economic development.
- A percentage of fees should go to neighboring tribes to help them accomplish shared tribal/Park objectives.
- Help the Hualapai Tribe with take-out facilities.
- NPS should assist in controlling trespass on tribal land and sacred sites and increase education of river users about tribal authority.
- Maintain income for the Hualapai Tribe by keeping the Whitmore exchange.
- Work with the Hualapai Tribe to preclude helicopter use and up river travel above Diamond Creek.
- Multiple suggestions were offered for improving the Diamond Creek area (e.g., more ramadas, better toilet facilities).
- The Hualapai Tribe should abide by the same standards/regulations as other users; should work with the NPS to avoid uses of tribal land incompatible with national park values; should reduce operations below Diamond Creek to reduce noise and crowding.
- Diamond Creek Road condition and need for more facilities along the road and at Peach Springs.

TRIP LENGTH / GROUP SIZE

- Do not manage group size and/or trip length.
- Trip lengths should remain unchanged; the system works well as it is. Various trip lengths should continue to be allowed to provide a variety of experiences.

TRIP LENGTH / GROUP SIZE (CONT.)

- All trips should be the same length.
- It is important to allow short trips (week or less) for those who are limited by time and/or money. Shorten trip length by increasing the allowable speed of motorized craft, by allowing and encouraging exchanges.
- Reduce non-commercial trip length to allow more access for others.
- Increase the allowable length of trips (commercial and non-commercial) to permit more hiking, a slower pace, a more contemplative experience; reduce the number of short trips.
- Maintain the current maximum commercial and non-commercial group sizes.
- Group size limits should be the same for all users.
- Decrease the maximum commercial and non-commercial group sizes. Large group sizes and large boats increase a sense of crowding; provide less opportunity for solitude and quiet; require large camping beaches that are limited in number. Large groups and double camping result in greater resource impacts.
- Number of boats on large non-motorized trips creates on-river congestion (more difficult to pass) and crowding at attraction sites.
- Increase or maintain opportunities for very small groups to provide a greater range of experiences.
- Eliminate small groups to allow more use.

VISITOR EXPERIENCE

- Thousands of comments were received that described valued attributes of a river trip experience but did not raise issues or concerns.

VISITOR SERVICES

- Provide a wide range of river running opportunities for people with different skill levels, time constraints, levels of income, physical needs, and for those who desire different kinds of experiences.
- Opportunities for river users should include educational trips.
- Allow access and egress at any point for inflatable kayaks.
- Allow commercial operations to continue (at existing level or increase). They permit greater access and provide valuable services (e.g., education, safety for both passengers and non-commercial trips, camp hygiene, stewardship of resources, supervision to constrain behavior, environmental awareness). They share provisions with non-commercial users and allow repeat use for clients.
- Commercial outfitters run more responsible trips than non-commercial users because of concession contract requirements. Non-commercial users lack supervision and are less safe, clean, protective of resources, considerate of other users, more likely to impact off-river resources from more hiking.

- Commercial trips provide opportunities for shorter trips.
- Commercial and non-commercial passengers need better education about river etiquette.
- Eliminate or reduce commercial operations. Profit making is inconsistent with national park purposes and values; advertising inflates demand for commercial use.
- The concessions as currently managed violate NPS policies and mandates (e.g., minimum tool requirement, wilderness management, providing public access at reasonable prices). NPS should reform the system (e.g., enforce strict adherence to NPS regulations, limit profit, do not give preference to current concession holders when contracts expire, consolidate all companies into one, break up large companies into smaller ones). NPS should reassess the level of commercial services needed on the river before renewing contracts.
- The ratio of commercial guides to passengers seems right and should remain the same. The ratio should increase to provide better supervision.
- Non-commercial trips should be allowed to use paid guides and/or rental services.
- Non-commercial trips should not be allowed to use paid guides and/or rental services.
- Permit bonfires below Diamond Creek.
- Do not permit additional riverside facilities.
- Improve infrastructure, both physical facilities on river and technological communications with the public (web communication with users, e.g., calendar of launches, research results); improve ramp at Lees Ferry; increase facilities at Phantom Ranch, including an ice machine and a water line down to the boat beach; add more facilities like Phantom Ranch at other locations but keep them unobtrusive; dredge channel in Lower Granite Gorge to restore more natural river flow.
- Improve human waste disposal procedures and facilities; provide waste disposal at termination points.
- Provide better emergency communications.
- Commercial river running represents a historic use/livelihood that needs to be protected and preserved.

PUBLIC COMMENT ISSUES OUTSIDE OF SCOPE

Wild and Scenic River Designation

- The river should receive Wild and Scenic River designation.
- Changes to the character of the river corridor and water quality (color and temperature) due to dam operations make the river ineligible for Wild & Scenic designation.

PUBLIC COMMENT ISSUES OUTSIDE OF SCOPE (cont.)

Wilderness

- The river corridor should receive Wilderness designation to protect and enhance its wilderness values. The NPS should recommend designation as part of the CRMP process (the scope of the CRMP should include Wilderness designation).
- The NPS has been remiss in not following up on the Wilderness proposal before now.
- Designate the river corridor as Wilderness but exclude the Phantom Ranch area; consider removing the structures at Phantom Ranch.
- The river should not receive Wilderness designation. The corridor is not wilderness because of dam operations and high recreational use. Wilderness designation would reduce public access.
- If Wilderness is not designated, at least manage the Colorado River as wilderness (allow a wilderness experience).

Glen Canyon Dam

- The scope of the CRMP should include effects of Glen Canyon Dam.
- Glen Canyon Dam should be operated in the most environmentally and recreationally (e.g., minimum safe flows) sensitive manner possible; NPS should have more influence on dam operations.
- Multiple suggestions were offered for improved operation of Glen Canyon Dam (e.g., lower fluctuations, beach-building flows, drawing warmer water from top of reservoir).

- Dam-caused changes are unnatural and unacceptable (e.g., loss of native fish, loss of wilderness, disruption of sediment flow, loss of camping beaches, cold water temperatures).
- Glen Canyon Dam should be removed to restore the natural river system.
- Glen Canyon Dam should not be removed; preserve species, such as trout, that have taken advantage of the altered river.

Overflights

- Restrict or eliminate overflights.
- Continue overflights.

Miscellaneous

- Comments concerning effects of automobile exhaust and power plant emissions on air quality at Grand Canyon.
- Comments concerning facilities on the South Rim.
- Comments concerning use of mules and conditions on the Bright Angel and Kaibab Trails.
- Comments concerning Diamond Creek Road condition and need for more facilities along the road and at Peach Springs.
- Comments concerning management of Lake Powell and Lake Mead beyond the GRCA boundary.
- Comments concerning tribal boundaries with the Park.
- Comments on proposed federal actions in other locations.

APPENDIX C: SOILS

Appendix C contains two parts:

1. A list of the soil types found in the river corridor.
2. A Site Inventory Table with impact ratings, current use intensity, type of impact, campsite size, and other information by site location. The table is based upon data from the Grand Canyon River Trip Simulator, Kaplinski, NPS Biophysical Impact Survey by Jalbert and Brown, and the 1989 Colorado River Management Plan. A key to the codes in the table is provided below:

| | | | | | |
|-------------------------------|-------------------------------------|-----------------------------|----------------------|--------------------------------------|--|
| Key to Colors in Table: | Campsite may no longer be usable | No data or day- use only | Y= Indicator site | Indicator site with Hiker Impacts | Indicator site which is a day-use only attraction |
|-------------------------------|-------------------------------------|-----------------------------|----------------------|--------------------------------------|--|

| | | | | | | |
|-----------------------|--------------------|-------------|-----------|--------------|-------------------|--------------|
| Impact Rating: | H= High | M= Moderate | L= Low | | | |
| Use Intensity Rating: | H= High | M= Moderate | L= Low | | | |
| Campsite Size: | L= Large | M= Medium | S= Small | | | |
| Type of Impact: | A= Attraction Site | C= Campsite | H= Hikers | D= Departure | R= Rapid Scouting | F= Fishermen |

**Soils Types found along to the Colorado River in Grand Canyon by Reach
Data from the NRCS Soils Map 2003**

| Reach # | |
|-------------|--|
| Reach Miles | |
| #1 | 107 Lithic Torriorthents (Moenkopi, Kaibab, Toroweap) Colluvium derived from limestone, sandstone, shale |
| 0-11.3 | 106 Lithic Torriorthents (Kaibab, Toroweap, Coconino) Colluvium derived from limestone, sandstone, shale |
| | 116 Typic Torriorthents (Hermit) Colluvium derived from limestone and sandstone |
| #2 | 116 Typic Torriorthents (Hermit) Colluvium derived from limestone and sandstone |
| 11.3-22.6 | 109 Lithic Torriorthents (Supai Group) Colluvium derived from calcareous sandstone |
| | 117 Typic Torriorthents (Tonto Group and Redwall) Colluvium derived from limestone, sandstone, shale and/or residuum weathered from limestone |
| #3 | 117 Typic Torriorthents (Tonto Group and Redwall) Colluvium derived from limestone, sandstone, shale and/or residuum weathered from limestone |
| 22.6-35.9 | |
| #4 | 117 Typic Torriorthents (Tonto Group and Redwall) Colluvium derived from limestone, sandstone, shale and/or residuum weathered from limestone |
| 35.0-61.5 | 145 Typic Torrifluvents-Typic Torripsamments complex Alluvium derived from mixed sources |
| #5 | 117 Typic Torriorthents (Tonto Group and Redwall) Colluvium derived from limestone, sandstone, shale and/or residuum weathered from limestone |
| 61.5-77.4 | 146 Typic Torriorthents (Badlands, Chuar Group) Residuum weathered from mudstone |
| | 145 Typic Torrifluvents-Typic Torripsamments complex Alluvium derived from mixed sources |
| | 104 Lithic Torriorthents (Cardenas) Colluvium and/or residuum weathered from basalt |
| | 137 Typic Haplocalcids-Typic Calciargids complex Alluvium |
| | 68 Lithic Torriorthents (Dox Formation) Colluvium and/or residuum weathered from sandstone, shale |
| | 58 Lithic Haplargids (Shinumo) Residuum weathered from quartzite |
| | 105 Lithic Torriorthents (Hakatai) Colluvium derived from shale |
| #6 | 105 Lithic Torriorthents (Hakatai) Colluvium derived from shale |
| 77.4-117.8 | 145 Typic Torrifluvents-Typic Torripsamments complex Alluvium derived from mixed sources |
| | 110 Lithic Torriorthents (Vishnu Schist) Colluvium derived from mica schist and/or eolian sands |
| | 101 Rock outcrop (Akela complex) Colluvium derived from schist and/or granite, and/or eolian deposits derived from limestone and sandstone |
| | 128 Torriorthents-Lithic Haplargids (Tonto Group) Colluvium derived from limestone, sandstone, shale |
| #7 | 128 Torriorthents-Lithic Haplargids (Tonto Group) Colluvium derived from limestone, sandstone, shale |
| 117.8-125.5 | |
| #8 | 128 Torriorthents-Lithic Haplargids (Tonto Group) Colluvium derived from limestone, sandstone, shale |
| 125.5-139.9 | 110 Lithic Torriorthents (Vishnu Schist) Colluvium derived from mica schist and/or eolian sands |
| | 144 Typic Torrifluvents-Typic Torripsamments complex Alluvium derived from mixed sources |
| #9 | 128 Torriorthents-Lithic Haplargids (Tonto Group) Colluvium derived from limestone, sandstone, shale |
| 139.9-159.9 | |
| #10 | 128 Torriorthents-Lithic Haplargids (Tonto Group) Colluvium derived from limestone, sandstone, shale |
| 159.9-213.8 | 144 Typic Torrifluvents-Typic Torripsamments complex Alluvium derived from mixed sources |
| | 70 Lithic Torriorthents (Muav and Redwall) Colluvium and/or residuum weathered from limestone |
| | 57 Lava Flows Typic Torriorthents Alluvium and/or colluvium derived from basalt |
| | 67 Lithic Torriorthents-Lithic Calciargids (Bright Angel and Tapeats Thermic) Residuum weathered from calcareous shale |
| #11 | 103 Rock outcrop-Lithic Torriorthents Colluvium derived from schist and/or sandy eolian deposits from mixed sources |
| 213.8-235.0 | |
| #12 | 103 Rock outcrop-Lithic Torriorthents Colluvium derived from schist and/or sandy eolian deposits from mixed sources |
| 235.0-276.6 | 143 Typic Torrifluvents Alluvium |
| | 66 Lithic Torriorthents-Lithic Calciargids (Bright Angel and Tapeats) Residuum weathered from calcareous shale |

| River Mile | RiverSide | NAME | Impact Rating | Current Use Intensity | Type of Impact | Indicator Site? | Area of ResourcConcern | Critical Reach? | Reach Number | Camp-site Size | See Color Key Above | | |
|------------|-----------|---------------------|---------------|-----------------------|----------------|-----------------|------------------------|-----------------|--------------|----------------|---------------------|--|--|
| 0.00 | R | LEES FERRY | | | | | | | 1 | | | | |
| 5.80 | R | 6 MILE | M | L | F, L | Y | Yes | NC | 1 | M | | | |
| 8 | L | JACKASS | M | M | F, H | | | NC | 1 | L | | | |
| 8 | R | BADGER | H | H | C,F,H | | | NC | 1 | M | | | |
| 8.5 | L | BELOW JACKASS | H | M | F | | | NC | 1 | S | | | |
| 11 | R | SOAP CREEK | H | H | C,F,H | Y | Yes | C | 1 | M | | | |
| 11.80 | L | BROWN'S INSCRIPTION | L | M | A,F | | | C | 2 | M | | | |
| 12.80 | R | 13 MILE | L | M | C | | | C | 2 | M | | | |
| 16.40 | L | HOT NA NA | M | H | C | | | C | 2 | L | | | |
| 17.00 | R | HOUSE ROCK | M | M | C,F,H,R | | | C | 2 | M | | | |
| 18.10 | L | 18 MILE LEDGES | M | M | C | | | C | 2 | M | | | |
| 19.00 | R | | M | M | C | | | C | 2 | M | | | |
| 19.10 | L | | M | M | C,H | | | C | 2 | M | | | |
| 19.90 | L | 20 MILE | M | M | C | | | C | 2 | M | | | |
| 20.40 | R | UPR NORTH CYN | M | H | A,C | Y | No | C | 2 | L | | | |
| 20.50 | R | LWR NORTH CYN | M | M | C | | | C | 2 | | | | |
| 21.50 | L | | L | M | C | | | C | 2 | S | | | |
| 21.90 | R | | L | M | C | | | C | 2 | M | | | |
| 23.00 | L | INDIAN DICK | M | M | C | | | C | 3 | L | | | |
| 23.70 | L | LONE CEDAR | M | L | C | Y | No | C | 3 | M | | | |
| 24.50 | L | 24.5 MILE | M | M | C,R | | | C | 3 | M | | | |
| 26.30 | L | ABOVE TIGER WASH | | | C | | | C | 3 | M | | | |
| 29.30 | L | SHINUMO WASH | M | M | C | | | C | 3 | L | | | |
| 30.40 | R | FENCE FAULT | M | M | C | Y | Yes | C | 3 | L | | | |
| 31.60 | R | SOUTH CANYON | H | H | A,C,F,H | Y | Yes | C | 3 | L | | | |
| 32.80 | L | REDWALL | L | H | A | | | C | 3 | | | | |
| 33.60 | L | BELOW REDWALL | L | L | C | | | C | 3 | S | | | |
| 34.00 | L | LITTLE REDWALL | L | M | C | | | C | 3 | M | | | |
| 34.80 | L | NAUTILOID | M | M | A,C | | | C | 3 | L | | | |

| | | | | | | | | | | | | | |
|-------|---|---------------------|---|---|-------|---|-----|----|---|---|--|--|--|
| 37.70 | L | TATAHATSO | M | L | C | | | C | 4 | M | | | |
| 38.30 | L | MARTHA'S | L | L | C | Y | No | C | 4 | M | | | |
| 39.00 | R | REDBUD ALCOVE | L | L | A | | | C | 4 | M | | | |
| 40.90 | R | UPR BUCKFARM | L | L | C | | | NC | 4 | S | | | |
| 41.00 | R | LWR BUCKFARM | M | M | A,C | Y | Yes | NC | 4 | L | | | |
| 43.20 | L | ANASAZI BRIDGE | L | L | A,C | | | NC | 4 | M | | | |
| 43.30 | L | LWR ANASAZI | L | L | C | | | NC | 4 | M | | | |
| 43.80 | L | PRES HARDING | M | M | A,C | | | NC | 4 | L | | | |
| 44.20 | L | EMINENCE | H | M | C,H | Y | No | NC | 4 | L | | | |
| 44.60 | L | | | | | | | NC | 4 | S | | | |
| 44.80 | L | WILLIE TAYLOR | L | L | A | | | NC | 4 | S | | | |
| 46.90 | L | DUCK N QUACK | L | L | C | | | NC | 4 | S | | | |
| 47.20 | R | UPR SADDLE | H | H | A,C | Y | Yes | NC | 4 | L | | | |
| 47.30 | R | LWR SADDLE | L | L | C | | | NC | 4 | L | | | |
| 50.00 | R | DINOSAUR | M | L | C | | | NC | 4 | L | | | |
| 51.20 | L | | | | C | | | NC | 4 | S | | | |
| 51.40 | L | | | | | | | NC | 4 | S | | | |
| 51.80 | R | LITTLE NANKOWEAP | M | M | A,C | Y | Yes | NC | 4 | M | | | |
| 52.60 | R | UPR NANKOWEAP | M | M | A,C,H | | | NC | 4 | L | | | |
| 53.00 | R | NANKOWEAP | H | H | A,C,H | Y | Yes | NC | 4 | L | | | |
| 53.20 | R | LWR NANKOWEAP | H | H | A,C | | | NC | 4 | M | | | |
| 56.20 | R | KWAGUNT | M | M | A,C | | | NC | 4 | L | | | |
| 56.70 | R | LOWER KWAGUNT | L | L | A,C | | | NC | 4 | M | | | |
| 57.50 | R | MALAGOSA | L | L | C | | | NC | 4 | M | | | |
| 57.50 | L | OPP. MALAGOSA | L | L | C | | | NC | 4 | M | | | |
| 58.20 | R | AWATUBI | M | L | C | Y | Yes | NC | 4 | S | | | |
| 58.60 | L | BELOW AWATUBI LEFT | M | L | C | | | NC | 4 | S | | | |
| 59.00 | R | BELOW AWATUBI RIGHT | M | L | C | | | NC | 4 | L | | | |
| 59.80 | R | 60 MILE | M | L | C | | | NC | 4 | S | | | |

| | | | | | | | | | | | | | |
|-------|---|------------------|---|---|---------|---|-----|----|---|----|--|--|--|
| 60.80 | R | | L | L | C | | | NC | 4 | M | | | |
| 61.00 | L | 61 MILE | | | | | | NC | 4 | S | | | |
| 61.20 | R | ABOVE LCR | M | M | C | Y | Yes | NC | 4 | L | | | |
| 61.40 | L | LITTLE COLORADO | M | H | A,H | Y | Yes | NC | 4 | | | | |
| 61.70 | R | BELOW LCR | L | L | C | | | NC | 5 | M | | | |
| 62.60 | R | CRASH CYN | L | M | A,C | | | NC | 5 | M | | | |
| 64.70 | R | CARBON | H | H | A,C,H | Y | No | NC | 5 | L | | | |
| 65.50 | R | LAVA CYN | H | H | A,C,H | | | NC | 5 | M | | | |
| 65.70 | L | PALISADES | M | L | A,C,H | | | | 5 | M | | | |
| 66.30 | L | ABOVE ESPEJO | L | L | C | | | NC | 5 | S | | | |
| 66.80 | L | ESPEJO | L | L | C | | | NC | 5 | S | | | |
| 68.40 | R | TANNER | M | M | A,C | | | NC | 5 | L | | | |
| 69.80 | R | LWR BASALT | L | L | C | | | NC | 5 | M | | | |
| 71.00 | L | CARDENAS | H | M | A,C,H | Y | Yes | NC | 5 | L | | | |
| 71.90 | R | UPR UNKAR | M | M | C | | | NC | 5 | M | | | |
| 72.30 | L | UNKAR | H | M | A | | | NC | 5 | M | | | |
| 73.60 | R | BELOW GRANARY | | | | | | NC | 5 | S | | | |
| 74.10 | R | U RATTLESNAKE | M | M | C | | | NC | 5 | L | | | |
| 74.30 | R | L RATTLESNAKE | M | M | C | | | NC | 5 | <S | | | |
| 75.60 | L | NEVILLS | M | M | C | | | NC | 5 | L | | | |
| 75.80 | R | PAPAGO | M | M | C | | | C | 5 | M | | | |
| 76.60 | L | HANCE | H | H | A,C,H,R | Y | Yes | C | 5 | M | | | |
| 78.90 | L | BELOW SOCK | L | L | C | | | C | 6 | S | | | |
| 81.30 | L | GRAPEVINE | M | H | C | | | C | 6 | L | | | |
| 84.00 | R | CLEAR CK | L | M | A,C | | | C | 6 | <S | | | |
| 84.40 | L | ABOVE ZOROASTER | L | M | C | | | C | 6 | M | | | |
| 87.10 | L | UPR CREMATION | H | H | C | Y | Yes | C | 6 | M | | | |
| 87.20 | L | LWR CREMATION | H | H | C | Y | Yes | C | 6 | M | | | |
| 87.80 | R | PHANTOM | H | H | A,D,H | | | C | 6 | | | | |
| 89.00 | L | PIPE CREEK | M | H | D,H | | | C | 6 | | | | |
| 89.30 | R | BELOW PIPE CREEK | | | | | | C | 6 | S | | | |
| 91.10 | R | 91 MILE CK | M | M | C | | | C | 6 | M | | | |

| | | | | | | | | | | | | | |
|--------|---|-----------------|---|---|-------|---|-----|----|---|---|--|--|--|
| 91.60 | R | TRINITY CK | M | M | C | | | C | 6 | S | | | |
| 92.30 | L | ABOVE SALT CK | M | M | C | | | C | 6 | M | | | |
| 93.40 | L | GRANITE | H | H | C,H,R | Y | No | C | 6 | M | | | |
| 94.30 | R | | L | L | C | | | | 6 | M | | | |
| 94.90 | L | HERMIT | H | H | C,H,R | | | | 6 | S | | | |
| 96.00 | R | UPR SCHIST | L | L | C | | | C | 6 | S | | | |
| 96.10 | L | SCHIST | H | H | C | | | C | 6 | L | | | |
| 98.00 | R | UPR CRYSTAL | H | H | C,R | Y | Yes | C | 6 | M | | | |
| 98.20 | R | LWR CRYSTAL | L | L | C | | | C | 6 | S | | | |
| 102.80 | R | NEW SHADY GROVE | M | L | C | | | C | 6 | S | | | |
| 103.80 | R | EMERALD | M | L | C | | | C | 6 | M | | | |
| 107.70 | L | HATATAI | H | M | C,H | Y | Yes | C | 6 | | | | |
| 107.80 | L | ROSS WHEELER | M | M | A,C,H | | | C | 6 | M | | | |
| 108.00 | R | PARKINS' INSCR | L | L | A,C | | | C | 6 | M | | | |
| 108.20 | R | LWR BASS | H | H | A,C,H | Y | Yes | C | 6 | L | | | |
| 108.70 | R | SHINUMO | M | H | A | Y | Yes | C | 6 | | | | |
| 109.40 | R | 110 MILE | M | M | C | | | C | 6 | L | | | |
| 114.30 | R | UPR GARNET | M | M | C | | | C | 6 | M | | | |
| 114.50 | R | LWR GARNET | M | M | C | | | C | 6 | M | | | |
| 116.50 | L | ELVES CHASM | H | H | A,H | Y | Yes | C | 6 | | | | |
| 118.10 | R | | L | L | C | | | NC | 7 | S | | | |
| 118.50 | L | | L | L | C | | | NC | 7 | M | | | |
| 119.00 | R | BIG DUNE | M | M | C | | | NC | 7 | L | | | |
| 119.20 | R | | L | L | C | | | NC | 7 | M | | | |
| 119.50 | L | SHADY GROVE | L | L | C | | | NC | 7 | M | | | |
| 119.80 | L | 120 MILE | H | H | C | | | NC | 7 | L | | | |
| 120.00 | L | OPP. BLACKTAIL | M | L | C | | | NC | 7 | S | | | |
| 120.00 | R | UPR BLACKTAIL | H | M | A,C | Y | Yes | NC | 7 | M | | | |
| 120.10 | R | LWR BLACKTAIL | M | M | A,C | Y | Yes | NC | 7 | M | | | |
| 120.20 | L | | L | L | C | | | NC | 7 | S | | | |
| 120.90 | L | | L | L | C | | | NC | 7 | S | | | |
| 121.50 | L | | L | L | C | | | NC | 7 | M | | | |
| 122.20 | R | 122 MILE | H | M | C | | | NC | 7 | L | | | |
| 122.70 | L | UPR FORSTER | L | L | C | | | NC | 7 | M | | | |
| 124.30 | L | ABOVE FOSSIL | L | L | C | | | NC | 7 | S | | | |
| 124.90 | L | FOSSIL | L | L | C | | | NC | 7 | M | | | |

| | | | | | | | | | | | | | |
|--------|---|---------------------|---|---|-------|---|-----|----|---|----|--|--|--|
| 125.40 | L | BELOW FOSSIL | M | L | C | Y | Yes | NC | 7 | | | | |
| 125.50 | L | | M | M | C | | | NC | 7 | L | | | |
| 126.50 | R | RANDY'S ROCK | M | M | C | | | NC | 8 | L | | | |
| 131.10 | R | BELOW BEDROCK | L | L | C | | | C | 8 | M | | | |
| 131.80 | R | GALLOWAY | H | M | C | Y | Yes | C | 8 | M | | | |
| 132.00 | R | STONE CK | M | H | A,C | | | C | 8 | M | | | |
| 133.00 | L | TALKING HEADS | L | L | C | | | C | 8 | M | | | |
| 133.50 | R | RACETRACK | L | L | A,C | Y | No | C | 8 | M | | | |
| 133.80 | R | TAPEATS | H | H | A,C,H | Y | Yes | C | 8 | S | | | |
| 133.90 | R | BELOW TAPEATS | L | L | A,C | | | C | 8 | <S | | | |
| 134.20 | L | ABV OWL EYES | L | L | C | | | C | 8 | M | | | |
| 134.60 | L | OWL EYES | L | L | C | | | C | 8 | M | | | |
| 135.40 | R | CHRISTMAS TREE CAVE | M | L | A | | | C | 8 | | | | |
| 135.50 | R | | L | L | C | | | C | 8 | | | | |
| 136.00 | L | JUNEBUG | L | L | C | | | C | 8 | S | | | |
| 136.20 | L | ACROSS DEER CK | H | H | C | | | C | 8 | M | | | |
| 136.20 | R | DEER CREEK | H | H | A,H | Y | Yes | C | 8 | | | | |
| 136.30 | L | OC'S | L | L | C | | | C | 8 | L | | | |
| 136.80 | L | PONCHO'S KITCHEN | H | H | C | Y | Yes | C | 8 | L | | | |
| 136.90 | L | FOOTBALL FIELD | M | H | C | Y | Yes | C | 8 | L | | | |
| 137.00 | L | BACKEDDY | H | H | A,C | Y | Yes | C | 8 | M | | | |
| 137.90 | L | DORIS | L | M | C | | | C | 8 | L | | | |
| 138.20 | L | | L | L | C | | | C | 8 | M | | | |
| 138.40 | L | | L | L | C | | | C | 8 | M | | | |
| 139.00 | R | FISHTAIL | | | | | | C | 8 | | | | |
| 139.80 | L | KEYHOLE | L | L | C | | | C | 8 | S | | | |
| 143.30 | L | ABOVE KANAB | L | L | C | | | C | 9 | S | | | |
| 143.50 | R | MOUTH OF KANAB | M | M | A,C | Y | Yes | C | 9 | S | | | |
| 144.20 | R | BELOW KANAB | L | L | C | | | C | 9 | S | | | |
| 145.10 | L | ABOVE OLO | L | L | C | | | C | 9 | M | | | |
| 145.60 | L | OLO | L | L | A | | | C | 9 | <S | | | |
| 147.90 | R | OPP MATKAT | L | L | C | | | C | 9 | <S | | | |
| 147.90 | L | MATKATAMIBA | M | H | A | | | C | 9 | | | | |

| | | | | | | | | | | | | | |
|--------|---|-----------------|---|---|-----|---|-----|----|----|----|--|--|--|
| 148.40 | L | MATKAT HOTEL | M | M | C | Y | Yes | C | 9 | M | | | |
| 148.50 | L | BELOW MATKAT | M | M | C | | | C | 9 | | | | |
| 150.30 | L | UPSET HOTEL | L | L | C | | | C | 9 | M | | | |
| 151.30 | R | UPPER LEDGES | L | L | C | | | C | 9 | M | | | |
| 151.50 | R | LEDGES | H | M | A,C | Y | No | C | 9 | L | | | |
| 155.70 | R | LAST CHANCE | M | M | C | | | C | 9 | M | | | |
| 156.80 | L | HAVASU | H | H | A,H | Y | Yes | C | 9 | | | | |
| 157.70 | R | FIRST CHANCE | L | M | C | | | C | 9 | M | | | |
| 158.20 | R | 158 MILE | L | L | C | | | C | 9 | M | | | |
| 158.50 | R | SECOND CHANCE | M | L | C | | | C | 9 | | | | |
| 160.00 | L | 160 MILE | L | L | C | | | C | 10 | M | | | |
| 160.70 | R | | L | L | C | | | C | 10 | M | | | |
| 164.50 | R | TUCKUP | M | M | C,H | | | NC | 10 | L | | | |
| 164.80 | L | BELOW TUCKUP | L | L | C | | | NC | 10 | S | | | |
| 166.50 | L | UPR NATIONAL | H | M | A,C | Y | Yes | NC | 10 | M | | | |
| 166.60 | L | LWR NATIONAL | M | M | A,C | Y | Yes | NC | 10 | L | | | |
| 167.00 | L | BELOW NATIONAL | | | | | | NC | 10 | <S | | | |
| 167.20 | L | | | | | | | NC | 10 | M | | | |
| 168.00 | R | FERN GLEN | M | M | A,C | | | NC | 10 | L | | | |
| 171.00 | R | STAIRWAY CYN | L | L | C | | | NC | 10 | M | | | |
| 171.60 | L | MOHAWK | L | L | C | | | NC | 10 | M | | | |
| 172.10 | L | 172 MILE | L | L | C | | | NC | 10 | M | | | |
| 173.00 | R | | | | | | | NC | 10 | M | | | |
| 174.30 | R | UPR COVE | L | L | C | | | NC | 10 | M | | | |
| 174.40 | R | LWR COVE | H | M | C | Y | Yes | NC | 10 | L | | | |
| 176.00 | L | BELOW RED SLIDE | M | M | C | | | NC | 10 | L | | | |
| 177.10 | L | HONGA SPRING | L | L | C | | | NC | 10 | M | | | |
| 177.70 | L | ABOVE ANVIL | L | L | C | | | NC | 10 | S | | | |
| 178.00 | R | VULCAN'S ANVIL | L | L | C | | | NC | 10 | S | | | |
| 179.00 | L | ABOVE LAVA | L | L | C | | | NC | 10 | M | | | |
| 179.20 | R | JUST ABOVE LAVA | M | H | R | | | NC | 10 | S | | | |
| 179.70 | R | BELOW LWR LAVA | M | L | C | | | NC | 10 | L | | | |
| 181.80 | R | 182 MILE | L | L | C | | | NC | 10 | S | | | |

| | | | | | | | | | | | | | |
|--------|---|---------------------|---|---|-----|---|-----|----|----|----|--|--|--|
| 182.50 | L | HELL'S HOLLOW | L | L | C | | | NC | 10 | S | | | |
| 182.50 | R | UPR CHEVRON | L | L | C | | | NC | 10 | M | | | |
| 182.60 | R | LWR CHEVRON | L | L | C | | | NC | 10 | M | | | |
| 182.80 | R | BELOW CHEVRON | | | | | | NC | 10 | M | | | |
| 182.80 | L | | | | | | | NC | 10 | M | | | |
| 183.00 | L | OLD HELIPAD | L | L | C | | | NC | 10 | S | | | |
| 184.50 | L | | | | | | | NC | 10 | L | | | |
| 185.30 | R | UPR 185 | M | M | C | | | NC | 10 | M | | | |
| 185.50 | R | 185 | M | M | C | | | NC | 10 | L | | | |
| 186.00 | L | | L | M | C | | | NC | 10 | M | | | |
| 186.20 | L | | L | L | C | | | NC | 10 | M | | | |
| 187.00 | L | WHITMORE HELIPAD | H | H | C,D | Y | Yes | NC | 10 | M | | | |
| 188.00 | R | WHITMORE WASH | M | M | A,C | | | NC | 10 | L | | | |
| 188.20 | R | LWR WHITMORE | L | L | C | | | NC | 10 | M | | | |
| 189.00 | L | | | | | | | | | S | | | |
| 191.80 | L | FAT CITY | L | L | C | | | NC | 10 | L | | | |
| 194.10 | L | HUALAPAI ACRES | L | L | C | | | NC | 10 | M | | | |
| 194.40 | L | 194 MILE | M | M | C | | | NC | 10 | M | | | |
| 196.40 | L | FROGGY FAULT | M | M | C | | | NC | 10 | L | | | |
| 196.50 | L | BELOW FROGGY | L | L | C | | | NC | 10 | S | | | |
| 198.50 | R | PARASHANT | H | M | C | Y | Yes | NC | 10 | M | | | |
| 200.50 | L | | | | | | | NC | 10 | <M | | | |
| 201.20 | R | | | | | | | NC | 10 | M | | | |
| 202.00 | R | 202 MILE | H | M | C | Y | Yes | NC | 10 | L | | | |
| 204.50 | R | SPRING CYN | | | A | | | NC | 10 | S | | | |
| 206.60 | R | INDIAN CYN | M | M | A,C | Y | Yes | NC | 10 | S | | | |
| 208.80 | L | GRANITE PARK | H | M | C | Y | Yes | NC | 10 | L | | | |
| 209.50 | R | | L | L | C | | | NC | 10 | L | | | |
| 210.00 | R | 210 MILE | | | | | | NC | 10 | M | | | |
| 210.70 | R | BIG CEDAR | | | | | | NC | 10 | M | | | |
| 211.20 | L | | | | | | | NC | 10 | <M | | | |
| 211.50 | R | UPR FALL CANYON | | | | | | NC | 10 | <M | | | |
| 211.70 | R | LWR FALL CYN | M | L | C | | | NC | 10 | S | | | |
| 212.90 | L | PUMPKIN SPRINGS | M | M | A,C | | | NC | 10 | M | | | |

| | | | | | | | | | | | | | |
|--------|---|------------------|---|---|-----|---|-----|----|----|---|-------|--|--|
| 213.50 | L | BELOW PUMPKIN | | | | | | NC | 10 | S | | | |
| 213.8 | R | 214 | L | L | C | | | NC | 11 | | | | |
| 215.6 | L | 3 SPRINGS | M | M | A | | | NC | 11 | | | | |
| 215.60 | R | OPP 3 SPRINGS | L | L | C | | | NC | 11 | S | | | |
| 216.40 | R | | L | L | C | | | NC | 11 | M | | | |
| 219.80 | R | UPPER 220-MILE | H | H | C | Y | Yes | NC | 11 | L | | | |
| 219.90 | R | MIDDLE 220-MILE | M | M | C | | | NC | 11 | M | | | |
| 220.00 | R | LOWER 220-MILE | L | L | C | | | NC | 11 | M | | | |
| 221.20 | R | 221-MILE | L | L | C | | | NC | 11 | M | | | |
| 222.00 | L | 222-MILE | H | M | C | Y | Yes | NC | 11 | L | | | |
| 223.00 | R | 223-MILE | L | L | C | | | NC | 11 | S | | | |
| 223.40 | L | 224-MILE | L | L | C | | | NC | 11 | M | | | |
| 224.50 | L | | M | M | C | | | NC | 11 | M | | | |
| 225.70 | L | DIAMOND CREEK | H | H | D | | | NC | 11 | | UPPER | | |
| 226.01 | R | TRUCKSEAT | M | L | C | | | C | 11 | | LOWER | | |
| 229 | L | TRAVERTINE CYN | H | H | A | | | C | 11 | S | | | |
| 230.5 | L | TRAVERTINE FALLS | H | H | A,C | | | C | 11 | M | | | |
| 235 | R | BRIDGE CANYON | L | L | C | | | C | 11 | M | | | |
| 236 | R | GNEISS CYN | M | M | C | | | C | 12 | M | | | |
| 238.5 | L | BRIDGE CYN CITY | M | M | A,C | | | C | 12 | | | | |
| 239.6 | R | SEPARATION | L | M | C | | | C | 12 | S | | | |
| 241.5 | R | 241 | L | L | C | | | C | 12 | M | | | |
| 241.5 | L | TAMMY EXP | L | L | A | | | C | 12 | S | | | |
| 242 | R | 242 | L | L | C | | | C | 12 | M | | | |
| 243.1 | R | 243 | L | L | C | | | C | 12 | M | | | |
| 246 | L | SPENCER | H | M | A,C | | | C | 12 | S | | | |
| 246.3 | R | LAVA CLIFFS | | | | | | C | 12 | S | | | |
| 248.2 | R | SURPRISE | L | L | A | | | C | 12 | | | | |
| 249.6 | R | | | | | | | C | 12 | M | | | |
| 257.1 | R | 257 BAR | L | M | C | | | C | 12 | M | | | |
| 259.5 | R | BURNT SPRINGS | M | M | A,C | | | C | 12 | S | | | |
| 260.1 | L | QUARTERMASTER | | | | | | C | 12 | S | | | |
| 264 | L | PADS/RAMADAS | H | H | A,D | | | C | 12 | | | | |
| 274.5 | L | COLUMBINE FALLS | L | L | A | | | C | 12 | | | | |

| | | | | | | | | | | | | | |
|-------|---|----------------------|--|--|--|--|--|---|----|--|--|--|--|
| 278.6 | L | SCORPION ISLAND | | | | | | C | 12 | | | | |
| 279 | L | LAKE MEAD TAKEOUT | | | | | | C | 12 | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

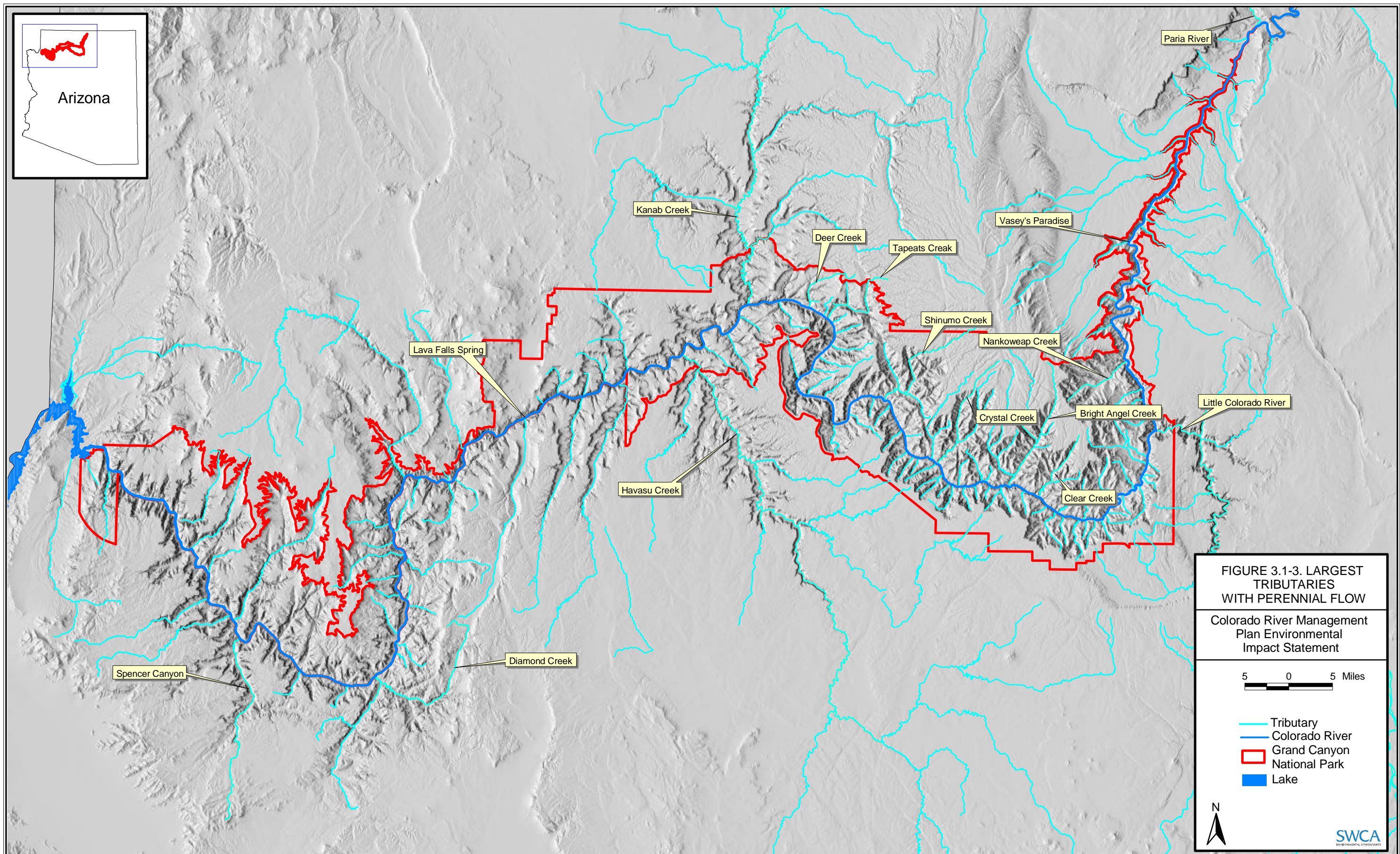
APPENDIX D: WATER QUALITY

Appendix D consists of a table (below) showing the largest tributaries in the river corridor, and then a map showing the Colorado River and its tributaries in the vicinity of Grand Canyon National Park.

Largest Tributaries Between Lees Ferry and the Grand Wash Cliffs.

| Source | Distance Downstream from Lees Ferry (river miles) | Estimated Annual Discharge (ac-ft) |
|----------------------------------|--|---|
| Paria River | 1.0 | 21,424 |
| Vasey's Paradise | 32.0 | 2,895 |
| Nankoweap Creek | 52.0 | 1,086 |
| Blue Spring (Little Colorado R.) | 61.5 | 161,300 |
| Clear Creek | 84.0 | 1,520 |
| Bright Angel Creek | 88.0 | 25,622 |
| Crystal Creek | 98.0 | 1,086 |
| Shinumo Creek | 108.5 | 6,587 |
| Tapeats Creek | 133.5 | 72,380 |
| Deer Creek | 136.0 | 5,211 |
| Kanab Creek | 143.0 | 2,823 |
| Havasupai Creek | 156.0 | 46,780 |
| Lava Falls Spring | 179.0 | 7,962 |
| Diamond Creek | 226.0 | 1,375 |
| Spencer Canyon | 246.0 | 1,954 |

Source: Arizona Department of Water Resources (2003).



APPENDIX E: AIR QUALITY

EDMS 4.11 Model Inputs for Study Whitmore Study

Date: Thursday, February 26, 2004

Study Created: Monday, October 27, 2003

Study Pathname: F:\Projects\SWCA\Grand Canyon\Whitmore Study\Whitmore Study.EDM

Airport: GRAND CANYON BAR TEN AIRSTRIP AZ 1Z1

Airport Location (lat / lon): 36-15-34.930N 113-13-52.762W

Field elevation: 4100 (feet MSL)

Average temperature: 59.0

Mixing Height: 3000 (feet)

Year being studied: 2003

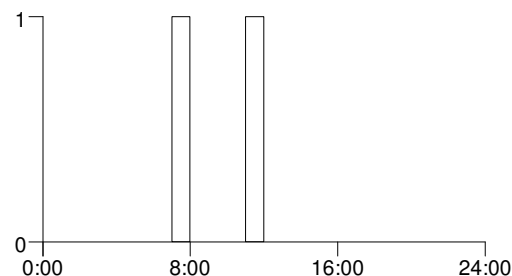
This study is an analysis of Emissions only.

GSE are modeled based upon aircraft LTO.

Hourly Operational Profiles

Name: DEFAULT

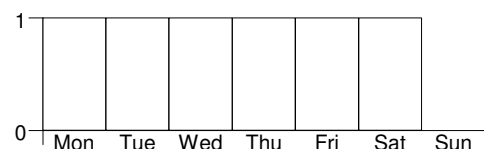
| Hour | Fraction of Peak | Hour | Fraction of Peak | Hour | Fraction of Peak |
|------|------------------|------|------------------|------|------------------|
| 1 | 0.0000 | 9 | 0.0000 | 17 | 0.0000 |
| 2 | 0.0000 | 10 | 0.0000 | 18 | 0.0000 |
| 3 | 0.0000 | 11 | 0.0000 | 19 | 0.0000 |
| 4 | 0.0000 | 12 | 1.0000 | 20 | 0.0000 |
| 5 | 0.0000 | 13 | 0.0000 | 21 | 0.0000 |
| 6 | 0.0000 | 14 | 0.0000 | 22 | 0.0000 |
| 7 | 0.0000 | 15 | 0.0000 | 23 | 0.0000 |
| 8 | 1.0000 | 16 | 0.0000 | 24 | 0.0000 |



Daily Operational Profiles

Name: DEFAULT

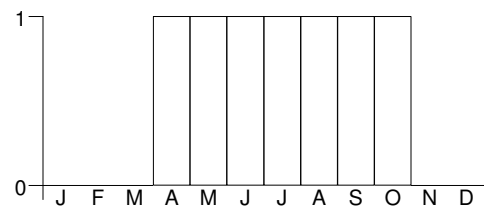
| Day | Fraction of Peak | Day | Fraction of Peak |
|-----------|------------------|----------|------------------|
| Monday | 1.0000 | Friday | 1.0000 |
| Tuesday | 1.0000 | Saturday | 1.0000 |
| Wednesday | 1.0000 | Sunday | 0.0000 |
| Thursday | 1.0000 | | |



Monthly Operational Profiles

Name: DEFAULT

| Month | Fraction of Peak | Month | Fraction of Peak |
|----------|------------------|-----------|------------------|
| January | 0.0000 | July | 1.0000 |
| February | 0.0000 | August | 1.0000 |
| March | 0.0000 | September | 1.0000 |
| April | 1.0000 | October | 1.0000 |
| May | 1.0000 | November | 0.0000 |
| June | 1.0000 | December | 0.0000 |

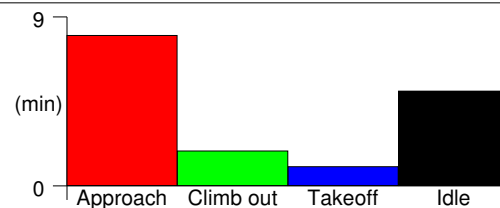


Aircraft

Aircraft Name: Cessna 441 Conquest2
 Engine Type: TPE331-8
 Identification: DO228

Annual LTOs: 418
 Annual TGO: 0
 Hourly Operational Profile: DEFAULT
 Daily Operational Profile: DEFAULT
 Monthly Operational Profile: DEFAULT
 Category: SGTP

Takeoff weight (lbs): 3000
 Approach angle (°): 3
 Takeoff Time (minutes): 1.03
 Climb out Time (minutes): 1.87
 Approach Time (minutes): 8.09
 Total Idle Time (minutes): 5.09
 Taxi & Queue Time (minutes): 5.00



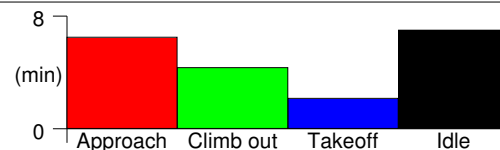
No APU assigned.

| Assigned GSE/AGE: | Fuel: | Op Time (mins): | Horsepower: | Load Factor: |
|--------------------------------|--------|-----------------|-------------|--------------|
| Fuel Truck, Small, < 3,000 gal | Diesel | 10.00 | 175 | 0.2500 |
| Ground Power Unit, 28VDC | Diesel | 40.00 | 71 | 0.7500 |

Aircraft Name: Bell 206
 Engine Type: 250B17B
 Identification: Bell Ranger

Annual LTOs: 1600
 Annual TGO: 0
 Hourly Operational Profile: DEFAULT
 Daily Operational Profile: DEFAULT
 Monthly Operational Profile: DEFAULT
 Category: SGTH

Takeoff Time (minutes): 2.17
 Climb out Time (minutes): 4.33
 Approach Time (minutes): 6.50
 Total Idle Time (minutes): 7.00
 Taxi & Queue Time (minutes): 7.00



No APU assigned.

| Assigned GSE/AGE: | Fuel: | Op Time (mins): | Horsepower: | Load Factor: |
|--------------------------------|--------|-----------------|-------------|--------------|
| Fuel Truck, Small, < 3,000 gal | Diesel | 10.00 | 175 | 0.2500 |
| Ground Power Unit, 28VDC | Diesel | 40.00 | 71 | 0.7500 |

User-Created GSE

**My Gse

Default Operating Time per LTO (minutes): 7.00
 Default Annual Operating Time (hours): 333
 Default Power Rating (Horsepower): 425
 Default Load Factor: 0.9000

Emissions data is based upon the following system GSE type operating in the specified year.

Gse Type: Air Start, 180 PPM
 Operating Year: 2009
 Default Fuel: Diesel

User-Created APUs

| | | |
|----------|---|------------|
| **My APU | Default Operating Time per LTO (minutes): | 26.00 |
| | Emissions Data Source: | APU WR27-1 |

End of Report

EDMS 4.11 Emissions Inventory Report

Airport: GRAND CANYON BAR TEN AIRSTRIP

Study Name: Whitmore Study

Report Date: 02/26/04

SUMMARY *(Tons/Year)*

| NAME | CO | HC | NOx | SOx | PM10 |
|-------------|-------|------|------|------|------|
| Aircraft | 1.275 | .174 | .429 | .049 | .000 |
| GSE/AGE/APU | .115 | .038 | .547 | .077 | .030 |
| Total | 1.390 | .212 | .976 | .126 | .030 |

AIRCRAFT EMISSIONS

(Tons/Year)

| Aircraft | Engine | Mode | CO | HC | NOx | SOx | PM10 |
|----------------------------------|----------|-------|-------|------|------|------|------|
| Cessna 441 00228 00228est2 | TPE331-8 | APCH | .073 | .003 | .160 | .017 | .000 |
| | | CLMB | .009 | .000 | .059 | .006 | .000 |
| | | TKOF | .004 | .000 | .036 | .003 | .000 |
| | | TAXI | .076 | .006 | .017 | .004 | .000 |
| | | TOTAL | .162 | .009 | .272 | .030 | .000 |
| | | APU | .000 | .000 | .000 | .000 | .000 |
| | | GSE | .024 | .008 | .113 | .016 | .006 |
| | | | | | | | |
| Bell 206 Bell Ranger | 250B17B | APCH | .357 | .039 | .017 | .004 | .000 |
| | | CLMB | .128 | .006 | .084 | .008 | .000 |
| | | TKOF | .060 | .002 | .051 | .004 | .000 |
| | | TAXI | .568 | .117 | .006 | .003 | .000 |
| | | TOTAL | 1.113 | .164 | .158 | .019 | .000 |
| | | APU | .000 | .000 | .000 | .000 | .000 |
| | | GSE | .091 | .030 | .434 | .061 | .024 |
| | | | | | | | |

VEHICULAR EMISSIONS
(Tons/Year)

| NAME | CO | HC | NOx | SOx | PM10 |
|------|------|------|------|------|------|
| | .000 | .000 | .000 | .000 | .000 |

STATIONARY SOURCE EMISSIONS
(Tons/Year)

| NAME | CO | HC | NOx | SOx | PM10 |
|------|------|------|------|------|------|
| | .000 | .000 | .000 | .000 | .000 |

EDMS 4.11 Model Inputs for Study Diamond Down Study

Date: Thursday, February 26, 2004

Study Created: Wednesday, February 11, 2004

Study Pathname: F:\Projects\SWCA\Grand Canyon\Lower Gorge Study\Lower Gorge Study.EDM

Airport: Lower Gorge Alternative E AZ 1Z1

Airport Location (lat / lon): 36-15-34.930N 113-13-52.762W

Field elevation: 4100 (feet MSL)

Average temperature: 59.0

Mixing Height: 3000 (feet)

Year being studied: 2003

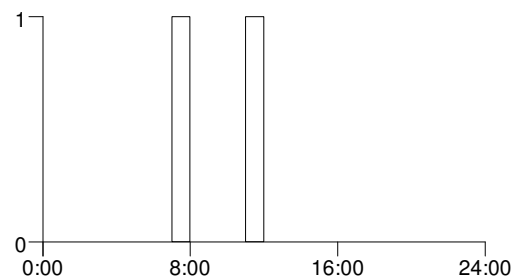
This study is an analysis of Emissions only.

GSE are modeled based upon aircraft LTO.

Hourly Operational Profiles

Name: DEFAULT

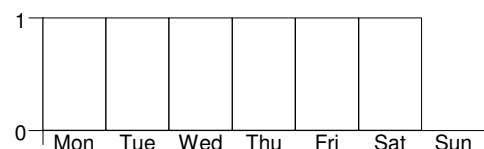
| Hour | Fraction of Peak | Hour | Fraction of Peak | Hour | Fraction of Peak |
|------|------------------|------|------------------|------|------------------|
| 1 | 0.0000 | 9 | 0.0000 | 17 | 0.0000 |
| 2 | 0.0000 | 10 | 0.0000 | 18 | 0.0000 |
| 3 | 0.0000 | 11 | 0.0000 | 19 | 0.0000 |
| 4 | 0.0000 | 12 | 1.0000 | 20 | 0.0000 |
| 5 | 0.0000 | 13 | 0.0000 | 21 | 0.0000 |
| 6 | 0.0000 | 14 | 0.0000 | 22 | 0.0000 |
| 7 | 0.0000 | 15 | 0.0000 | 23 | 0.0000 |
| 8 | 1.0000 | 16 | 0.0000 | 24 | 0.0000 |



Daily Operational Profiles

Name: DEFAULT

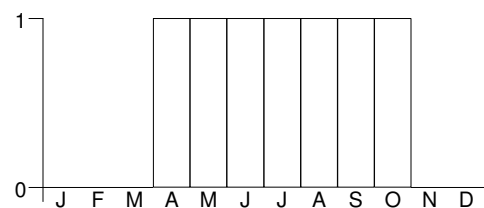
| Day | Fraction of Peak | Day | Fraction of Peak |
|-----------|------------------|----------|------------------|
| Monday | 1.0000 | Friday | 1.0000 |
| Tuesday | 1.0000 | Saturday | 1.0000 |
| Wednesday | 1.0000 | Sunday | 0.0000 |
| Thursday | 1.0000 | | |



Monthly Operational Profiles

Name: DEFAULT

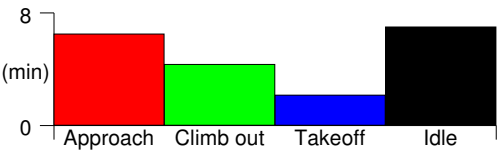
| Month | Fraction of Peak | Month | Fraction of Peak |
|----------|------------------|-----------|------------------|
| January | 0.0000 | July | 1.0000 |
| February | 0.0000 | August | 1.0000 |
| March | 0.0000 | September | 1.0000 |
| April | 1.0000 | October | 1.0000 |
| May | 1.0000 | November | 0.0000 |
| June | 1.0000 | December | 0.0000 |



Aircraft

| | | |
|-----------------|------------------------------|---------|
| Aircraft Name: | Annual LTOs: | 159000 |
| Bell 206 | Annual TGO: | 0 |
| Engine Type: | Hourly Operational Profile: | DEFAULT |
| 250B17B | Daily Operational Profile: | DEFAULT |
| Identification: | Monthly Operational Profile: | DEFAULT |
| Bell Ranger | Category: | SGTH |

| | |
|------------------------------|------|
| Takeoff Time (minutes): | 2.17 |
| Climb out Time (minutes): | 4.33 |
| Approach Time (minutes): | 6.50 |
| Total Idle Time (minutes): | 7.00 |
| Taxi & Queue Time (minutes): | 7.00 |



No APU assigned.
No GSE assigned.

User-Created GSE

| | | |
|----------|---|--------|
| **My Gse | Default Operating Time per LTO (minutes): | 7.00 |
| | Default Annual Operating Time (hours): | 333 |
| | Default Power Rating (Horsepower): | 425 |
| | Default Load Factor: | 0.9000 |

Emissions data is based upon the following system GSE type operating in the specified year.
Gse Type: Air Start, 180 PPM
Operating Year: 2009
Default Fuel: Diesel

User-Created APUs

| | | |
|----------|---|------------|
| **My APU | Default Operating Time per LTO (minutes): | 26.00 |
| | Emissions Data Source: | APU WR27-1 |

EDMS 4.11 Emissions Inventory Report

Airport: Lower Gorge Alternative E

Study Name: Diamond Down Study

Report Date: 02/26/04

SUMMARY *(Tons/Year)*

| NAME | CO | HC | NOx | SOx | PM10 |
|-------------|---------|--------|--------|-------|------|
| Aircraft | 110.543 | 16.332 | 15.652 | 1.891 | .000 |
| GSE/AGE/APU | .000 | .000 | .000 | .000 | .000 |
| Total | 110.543 | 16.332 | 15.652 | 1.891 | .000 |

AIRCRAFT EMISSIONS

(Tons/Year)

| Aircraft | Engine | Mode | CO | HC | NOx | SOx | PM10 |
|-------------|---------|-------|---------|--------|--------|-------|------|
| Bell 206 | 250B17B | APCH | 35.490 | 3.910 | 1.654 | .406 | .000 |
| Bell Ranger | | CLMB | 12.691 | .563 | 8.386 | .760 | .000 |
| | | TKOF | 5.953 | .229 | 5.030 | .412 | .000 |
| | | TAXI | 56.409 | 11.631 | .582 | .314 | .000 |
| | | TOTAL | 110.543 | 16.333 | 15.652 | 1.892 | .000 |
| | | APU | .000 | .000 | .000 | .000 | .000 |
| | | GSE | .000 | .000 | .000 | .000 | .000 |
| | | | | | | | |

VEHICULAR EMISSIONS
(Tons/Year)

| NAME | CO | HC | NOx | SOx | PM10 |
|------|------|------|------|------|------|
| | .000 | .000 | .000 | .000 | .000 |

STATIONARY SOURCE EMISSIONS
(Tons/Year)

| NAME | CO | HC | NOx | SOx | PM10 |
|------|------|------|------|------|------|
| | .000 | .000 | .000 | .000 | .000 |

APPENDIX F: CONSULTATION



United States Department of the Interior

U.S. Fish and Wildlife Service

2321 West Royal Palm Road, Suite 103

Phoenix, Arizona 85021-4951

Telephone: (602) 242-0210 FAX: (602) 242-2513



In Reply Refer to:

AESO/SE

02-21-89-I-0106-R1

April 29, 2004

Ms. Lenore Grover-Bullington
Grand Canyon National Park
823 North San Francisco Street Ste B
Flagstaff, Arizona 86001

Dear Ms. Grover-Bullington:

On March 23, 2004, we received your memorandum regarding review of the Colorado River Management Plan (CRMP) Administrative Draft Environmental Impact Statement (ADEIS). Your memorandum indicated that the attached ADEIS was being provided so that we could become familiar with the draft preferred alternatives and the potential impacts they may have on biological resources along the river. Your memorandum indicated that you would accept comments on the ADEIS until April 2, 2004, but that you were primarily interested in a list of species that should be included in a biological assessment of the proposed action.

Unfortunately, the timeframe provided was too short for us to review the ADEIS and provide comments by April 2. We understand that a Draft Environmental Impact Statement (DEIS) may be available for review by May 15, 2004. Please advise us whether you want comments on the ADEIS at this point and/or whether review of the DEIS may be more useful to you.

In addition to the general information below that we routinely provide in response to requests for formal consultation, we offer the following list of species that may be appropriate for consideration in your biological assessment of the proposed action.

bald eagle (*Haliaeetus leucocephalus*) - threatened
California condor (*Gymnogyps californianus*) - threatened (in Grand Canyon NP)
Mexican spotted owl (*Strix occidentalis lucida*) - threatened
southwestern willow flycatcher (*Empidonax traillii extimus*) - endangered
Yuma clapper rail (*Rallus longirostris yumanensis*) - endangered
humpback chub (*Gila cypha*) - endangered
razorback sucker (*Xyrauchen texanus*) - endangered
Kanab ambersnail (*Oxyloma haydeni kanabensis*) - endangered
yellow-billed cuckoo (*Coccyzus americanus*) - candidate
relict leopard frog (*Rana onca*) - candidate

For species lists, the Arizona Ecological Services Field Office has posted lists of the endangered, threatened, proposed and candidate species occurring in each of Arizona's 15 counties on the Internet. Please refer to the following web page for species information in the county where your project occurs: <http://arizonaes.fws.gov>. If you have difficulty obtaining a list, please contact our office and we will mail or fax you a list as soon as possible.

After opening the web site, click the Threatened and Endangered button on the left hand side of the page. Then scroll to the bottom of the page where there is a map of Arizona. You can either click on your county of choice on the map or from the list. The arrows on the left will guide you through the information on the species that are listed, proposed, candidates, or have conservation agreements. Here you will find information on the species' status, a physical description, and counties where the species occurs, habitat, elevation, and some general comments. Additional information can be obtained by going back to the main page. On the left side of the screen, click on Document Library, then click on Documents by Species, then click on the name of the species of interest to obtain General Species Information, or other documents that may be available. Click on the cactus icon to view the desired document.

Please note that your action area may not necessarily include all or any of these species. The information provided includes general descriptions, habitat requirements, and other information of each species on the list. Under the General Species Information, citations for the Federal Register (FR) are included for each listed and proposed species. The FR is available at most public libraries, and on the Internet. This information should assist you in determining which species may or may not occur within the action area. Site-specific surveys could also be helpful and may be needed to verify the presence or absence of a species or its habitat as required for the evaluation of proposed project-related impacts. We are also prepared to assist you in defining a species list for your project, particularly when we know more about the extent of the action.

Endangered and threatened species are protected by Federal law and must be considered prior to project development. If the action agency determines that listed species or critical habitat may be adversely affected by a federally funded, permitted or authorized activity, the action agency will need to request formal consultation with us. If the action agency determines that the planned action may jeopardize a proposed species or destroy or adversely modify proposed critical habitat, the action agency will need to enter into a section 7 conference. The county list may also contain candidate species. Candidate species are those for which there is sufficient information to support a proposal for listing. Although candidate species have no legal protection under the Act, we recommend that they be considered in the planning process in the event that they become listed or proposed for listing prior to project completion. In addition to species listed under the Act, we recommend you consider species protected under the Migratory Bird Treaty Act.

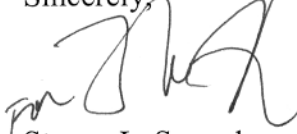
If any proposed action occurs in or near areas with trees and shrubs growing along watercourses, known as riparian habitat, we recommend the protection of these areas. Riparian areas are critical to biological community diversity and provide linear corridors important to migratory species. In addition, if the project will result in the deposition of dredged or fill materials into

waterways, we recommend you contact the Army Corps of Engineers which regulates these activities under Section 404 of the Clean Water Act.

The State of Arizona and some of the Native American Tribes protect some plant and animal species not protected by Federal law. We recommend you contact the Arizona Departments of Game and Fish, and Agriculture for State-listed or sensitive species, or contact the appropriate Native American Tribe to determine if sensitive species are protected by Tribal governments in your action area. We recommend that you invite the Arizona Game and Fish Department and any Native American Tribes in or near your project area to participate in your information or formal section 7 consultation process.

Thank you for the opportunity to review and comment on the proposed action. If we can be of further assistance, please contact Bill Austin (928) 226-0614 x102 or Brenda Smith (x101).

Sincerely,

A handwritten signature in black ink, appearing to read 'S. Spangle', with a long horizontal stroke extending to the right.

Steven L. Spangle
Field Supervisor

cc: Director, Science Center, Grand Canyon National Park, Grand Canyon AZ
Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix AZ

APPENDIX G: VISITOR USE AND EXPERIENCE

The impact analysis for visitor use and experience in Chapter 4 in the *Draft Environmental Impact Statement* assesses an array of alternatives that produce different, distinct opportunities. This appendix provides additional detail about impact measures, relevant literature, assumptions used in conducting the analysis, and research findings relevant to the visitor use and experience impact analysis. Much of the information contained in this appendix was provided by Doug Whittaker and Bo Shelby (Confluence Research & Consulting) in draft text submitted under contract to the National Park Service for this *Draft Environmental Impact Statement*.

Fundamental Principles

Several recreation management and planning concepts guide the visitor experience impacts analysis. First, there is a range of recreation opportunities available in Grand Canyon, even on the primitive end of the spectrum. The Recreation Opportunity Spectrum (ROS) concept, institutionalized by many federal and state agencies, recommends specifying types of trips when assessing the quality or quantity of opportunities (Driver et al. 1987; Manning 1999).

Second, recreation quality is related to many variables, and several recreation planning frameworks help specify those relationships (e.g., CCAP [Shelby and Heberlein 1986]; VIM [Graefe, Kuss, and Vaske 1990]; VERP [NPS 1997]; LAC [Stankey, Lucas, Petersen, and Frissell 1985]). As recommended by these frameworks, this analysis focuses on social indicators, standards, and management actions to reduce impacts when they exceed standards.

Third, there are trade-offs between the quantity and quality of recreation opportunities. Higher use levels produce higher social impacts, which may affect the quality or type of opportunities. However, lower use levels mean that fewer people can take river trips, have high quality experiences, and have the opportunity to understand the values of the canyon or similar wilderness-like areas.

River Encounters

Generally, river encounters result in direct, short-term, localized, adverse or beneficial impacts on visitor experience.

- Encounters are important to many river users, particularly in lower use, wilderness-like settings (Vaske et al., 1986; Shelby et al., 1996).
- As encounters increase, perceived crowding increases (Vaske & Donnelly, 2002).
- Measuring actual encounters is challenging (Shelby and Colvin, 1982). Few studies measure actual encounters, and most rely on user reports (“perceived” encounters). Numbers of encounters reported by visitors are generally lower than actual encounters

recorded by trained field technicians. When encounters are over five per day, reported encounters may underestimate actual encounters by about half.

- Measuring encounter standards is also challenging (Manning et al., 2002; Hall & Roggenbuck, 2002). Encounter preferences are generally lower than tolerances for a given type of experience (Manning et al., 2002).
- Not all encounters have equal effects on quality (Cole, 2001; Cole & Stewart, 2002). There may be differences for encounters that occur at different times and locations or with different types of groups.
- The effect of encounters varies for different users. Some are more solitude-seeking and sensitive to encounters while others are more gregarious, even in wilderness-like settings (Patterson & Hammitt, 1990; Jonas & Stewart, 2002). Information about the likely level of encounters for a setting may influence expectations, which interact with preferences and actual encounters to influence effects on trips (Shelby et al., 1983).
- Even with stable use levels, the number of encounters will vary by day or by trip, so it makes sense to focus on average encounter levels and reasonable ranges.
- Studies in wilderness and backcountry settings show agreement that encounter levels should be low (Vaske et al., 1986). In general, wilderness preferences are for fewer than 2 or 3 encounters per day (with many users preferring no encounters), while tolerances are slightly higher, about 4 or 5 per day. For less primitive backcountry experiences encounter tolerances are higher, but usually less than 10 encounters per day.

There is considerable specific information about river encounters in Grand Canyon from the 1975 and 1998 studies; the quality of encounter information is generally better than for any other river in the country (including actual encounter measurement as well as surveys of encounter preferences). Key findings and implications include the following:

- River encounters are important to Grand Canyon river runners. Over 96% of 1998 oar users (commercial + noncommercial) and 85% of motor passengers reported that river encounters were important, which indicates a high norm “prevalence” (Donnelly et al., 2000). Similarly, less than 10% of all visitors “would have enjoyed meeting more other groups” during their trips.
- Grand Canyon users prefer low levels of river encounters; nearly half prefer to see no other groups, and 75% prefer to see fewer than 2 (oar users) or 4 (motor passengers) per day.
- Overall, encounter tolerances in peak season are about 3 to 5 reported river encounters per day (with higher tolerances for commercial motor passengers, lower tolerances for noncommercial users, and commercial oar passengers in the middle). Tolerances in the shoulder and winter seasons are probably lower.
- The current 1989 *Colorado River Management Plan* encounter standard is “80% probability of 7 or less river encounters” in the summer. Although aspects of this standard are unclear, encounter levels of most current trips are probably within this standard (Hall & Shelby, 2000).

- During recent years, about 40% of all encounters are “repeat encounters” with a group seen previously that day (Hall & Shelby, 2000). This suggests many encounters are related to “leap-frogging” by groups on similar schedules. Repeat encounters are exacerbated by the current uneven, weekly use patterns that often launch many similar trips on the same days (See Chapter 2 for current uneven launch schedule graph). Patterns that spread out different types of trips will probably reduce repeat and overall encounter rates. All new alternatives have more even launch patterns.
- Daily encounter analyses suggest that higher averages can be caused by a few exceptionally high encounter days associated with exchanges or high use at attraction sites. These may also be exacerbated by uneven launch schedules (which are eliminated in new alternatives).
- Motor trips generally have more river encounters per day because they travel faster and farther. Analyses show encounter rates separately for motor vs. oar trips.
- Although river encounters vary by day and trip, average daily encounters for specific use levels are predictable. Encounter impacts are expressed as ranges to reflect the appropriate level of precision and are efficient for this analysis.
- In Grand Canyon (1975 data), almost half of the variation in river encounters is explained by use levels, which is remarkably high given the variation in trip schedules and the size of the area.

River Encounters and Use Levels

Grand Canyon studies show encounters are related to 1) launch levels and 2) use density as measured by trips at one time. Figures 1 and 2 show those relationships and form the basis for analyses of specific alternatives. They are based on 1998 data with consideration from the 1975 study and river launch simulator results. Relationships are most reliable between 4 and 6 launches per day or between 40 and 60 trips at one time (the most common ranges during the 1998 study).

Figure G-1 shows that encounters increase as more trips are launched per day. The arrows indicate that encounters would shift upward at any given launch level with higher trips at one time (if trips stayed in the canyon longer), or if launch patterns were more uneven.

Figure G-2 shows a similar relationship between trips at one time and encounters. Here the arrows indicate that encounters would shift upward at any given trips at one time with more launches (of shorter trips) or more uneven launch patterns.

FIGURE G-1: GENERAL RELATIONSHIP BETWEEN LAUNCHES AND AVERAGE RIVER ENCOUNTERS PER DAY

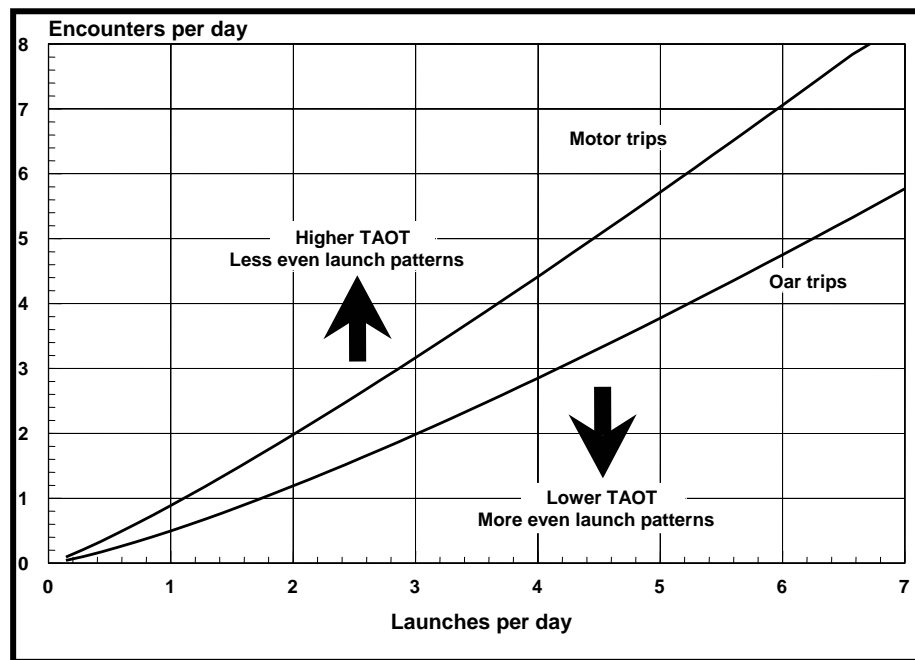
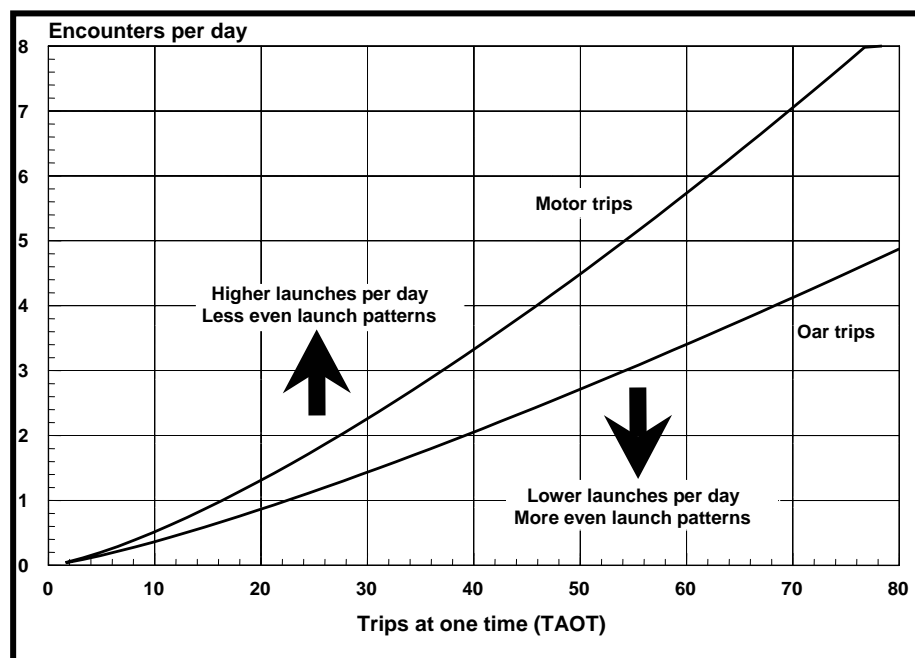


FIGURE G-2: GENERAL RELATIONSHIP BETWEEN TRIPS AT ONE TIME AND AVERAGE RIVER ENCOUNTERS PER DAY



Time in Sight

Time in sight refers to the amount of time (in minutes) that groups are in view during river encounters, which was measured during the 1975 and 1998 studies. Both Grand Canyon studies show time in sight tolerances for wilderness at 15% or less. NPS has established standards for time in sight in the current 1989 *Colorado River Management Plan* at 90 minutes per day, although it is unclear whether this refers to time in sight on the river, at attraction sites, in camp, or all three combined. Assumptions used for time in sight include:

- Applied to a five hour “on-the-water” period, 15% is about 45 minutes per day for in sight on the river.
- Applied to a 12-hour day, 15% equals about 1.75 hours when combined with in sight on the river, at attraction sites, and in camp.

Attraction Site Encounters

Attraction sites refer to places where river users stop to explore an area more extensively. They include side canyons, waterfalls, or archeological sites; at some sites users may also stop for lunch or camp. Attraction sites are important destinations that may be the focus of a day’s activities. There are about 100 sites that receive at least occasional use; of these, about 30 to 40 are regularly used, and five are “must see” sites visited by almost all trips. Two indicators (used in both the 1975 and 1998 studies) are helpful for understanding attraction site impacts. The probability of meeting another group reflects the opportunity to find solitude at attraction sites and is relevant for both lower and higher use sites. At sites with multiple groups (which is more likely at the five higher use sites), the question becomes “how many people is too many?” as measured by the average number of people observed. Generally, attraction site encounters result in direct, short-term, localized, adverse or beneficial impacts to visitor experience.

Based on the 1975 and 1998 Grand Canyon studies measuring attraction site encounters, assumptions used for attraction site encounters include:

- Most boaters prefer visiting attraction sites by themselves or to share them with few other people.
- Most boaters know (or soon learn) that encounters are likely at high use sites and possible at lower use sites.
- Commercial passengers are generally less sensitive to attraction site encounters than noncommercial users.
- On average, boaters will probably tolerate encounters at about 50% of the lower use attraction sites during summer trips, but off-season users probably prefer lower probabilities.
- Most boaters expect and will tolerate encounters at 80% of the five higher use sites in summer (e.g., on average, they will get to visit at least one with no encounters). In the non-summer season, most would prefer lower probabilities (about 60% or the probability to visit two of the five sites without other groups present).

- Acceptable densities at high use sites in summer are probably less than about 30 people (not in the same group). This is more likely to occur at Redwall and Elves Chasm than Little Colorado River, Deer Creek, and Havasu.
- Many boaters recognize that they have some ability to avoid high densities at the higher use sites by hiking farther; 86% of noncommercial users, 64% of commercial oar passengers, and 45% of motor passengers reported a willingness to do this.

Attraction Site Encounters and Use Levels

Compared to river encounters, attraction site encounters are less correlated with use levels because the geography and popularity of individual attraction sites play a larger role. The distribution of launch patterns through the week also appears to influence these impacts. Probabilities and densities vary considerably across sites, days, and trips; both indicators are affected by the sites visited and the way that stops are scheduled. Assumptions used for attraction site encounters and use levels include:

- Data from 1998 suggest that medium and high use levels (trips at one time between 50 and 65) produce similar probabilities of attraction encounters (about 85% at the five high use sites and 45% at the lower use sites). One possible explanation is that boaters may communicate and adjust their behavior more often at higher use levels. When trips at one time drop below 50, encounter probabilities drop to 55% at the five high use sites and 35% at the lower use sites. No data are available for TAOT levels below 35.
- The number of people seen at attraction sites appears to follow use levels more closely (based on 1998 data). At the five high use sites, the median number of people encountered was 30 during high use times, 23 during medium use times, and 6 during low use times. Even during high use periods most trips saw less than 55 other people, although a few trips saw over 100 in medium and high use periods.

Camp Encounters

There is no relationship between launch levels and camp encounters in Grand Canyon; 1998 data show there are similar rates of camp encounters at low, medium, and high use times. Camp encounters are related to geographical factors and trip scheduling. Groups have camp encounters in Grand Canyon when they stay at desirable camps that are in sight or sound of other desirable camps, especially near popular attraction sites or exchange points. Camp encounters may have direct, short-term, localized, adverse or beneficial impacts to visitor experience.

Table G-1 lists sites where camp encounters are most likely to occur, based on 1998 data. The sites are characterized by multiple camps (or a camp that can be shared), good hiking, and logistical value (because they set-up or are just downstream from an attraction sites or exchange point). The table includes a “use frequency index,” which suggests how often a site gets used (a function of the number of nights a site was used by the 1998 study trips). Groups that want to avoid camp encounters could avoid using these sites. The table includes

information about the attraction site or exchange point that appears to attract use to these camps.

TABLE G-1: EXAMPLE CAMPSITES WITH THE HIGHER RATES OF CAMP ENCOUNTERS

| | River Mile | Percentage of Nights with Encounters | Use Frequency " Index* | Comments |
|-------------------------|------------|--------------------------------------|------------------------|--|
| Saddle Canyon | 47 | 50 | 26 | Two sites. Hiking. Set-up for LCR. |
| Nevills | 75 | 50 | 9 | Two sites. Set-up for Upper Gorge rapids. |
| North Canyon | 20 | 45 | 24 | Two sites. Hiking. First night option. |
| Cremation | 87 | 44 | 19 | Camp sharing. Set-up for Phantom exchange. |
| Nankoweap | 52 | 42 | 41 | Multiple sites. Cultural site, hiking, layovers. |
| Mile 220 | 220 | 41 | 36 | Multiple sites. Set up for Diamond takeout. |
| Poncho's camps | 136 | 33 | 13 | Multiple sites. Across from Deer Creek. |
| Tapeats | 134 | 29 | 15 | Multiple sites. Layovers, hiking. |
| National Canyon | 166 | 23 | 28 | Two sites. Hiking. Below Havasu. |
| Ledges | 151 | 22 | 19 | Camp sharing. Set-up for Havasu. |
| Average for these sites | | 36 | | |
| Average for all sites | | 21 | | |

* Use frequency index from 1998 trip data = (# of nights used ÷ # nights on all trips) x average nights per trip. It roughly indicates the percentage likelihood that any particular trip would use a site.

Camp Competition

Camp competition is different from camp encounters. It can be measured by campsite occupancy level (number of occupied camps divided by the total number of camps), which is presumably related to the density of trips (trips at one time per mile).

A few studies have examined camp competition impacts and standards, although there has been less research on this indicator than river and camp encounters (and it has not been examined in Grand Canyon). Studies on ten rivers in Alaska asked boaters to specify the proportion of camps they wanted to use but could not because the camps were occupied, and then compared those with a parallel question about campsite competition tolerances (Whittaker et al., 1990; Whittaker, 1996; Whittaker et al., 2000).

Results suggest boaters are willing to pass up about 10 to 20% of camps on wilderness-like rivers and 30 to 50% on less primitive rivers. These camp competition percentages are theoretically similar to campsite occupancy rates (although studies have not specifically attempted to link them).

For this DEIS, camp competition analysis focuses on trips at one time and related campsite occupancy rates in Grand Canyon as an indicator, which also allows comparisons with other rivers. Table G-2 shows trip densities (average miles between trips) during high use periods on several multi-day rivers in North America and are intended to be illustrative rather than comprehensive.

Results suggest that Grand Canyon, even during current high use periods, has lower densities of trips than many other rivers during their peaks. Many of the "classic" multi-day trips

TABLE G-2: COMPARISON OF THE LEES FERRY TO DIAMOND CREEK SECTION OF THE COLORADO RIVER TO OTHER MULTI-DAY RIVERS IN NORTH AMERICA
(Ordered by Average Miles between Trips)

| Grand Canyon Compared to Other Multi-day River Trips | River Length | Average Trip Length | Launches per Day | Trips at One Time | Average Miles between Trips |
|---|---------------------|----------------------------|-------------------------|--------------------------|------------------------------------|
| Tatshenshini, Canada & AK | 140.0 | 12.0 | 0.5 | 6.0 | 23.0 |
| Selway, ID (wild section) | 47.0 | 5.0 | 1.0 | 5.0 | 9.4 |
| Birch Creek, AK | 126.0 | 7.0 | 2.0 | 14.0 | 9.0 |
| Grand Canyon (current shoulder average) | 226.0 | 14.3 | 2.0 | 24.0 | 9.4 |
| Middle Owyhee, OR | 35.0 | 3.0 | 2.0 | 6.0 | 5.8 |
| Grand Canyon (current shoulder peak) | 226.0 | 22 | 7.0 | 54.0 | 4.2 |
| Cataract, UT | 112.0 | 5.0 | 5.0 | 25.0 | 4.5 |
| Lower Owyhee, OR | 60.0 | 5.0 | 3.0 | 15.0 | 4.0 |
| John Day, OR (Service Ck to Clarno) | 47.0 | 4.0 | 3.0 | 12.0 | 3.9 |
| Grand Canyon (current summer average) | 226.0 | 10.1 | 5.5 | 55.0 | 4.1 |
| Rio Chama, NM (lower use periods) | 32.0 | 2.0 | 4.5 | 9.0 | 3.6 |
| Yampa in Dinosaur NP | 71.0 | 4.0 | 5.0 | 20.0 | 3.6 |
| Forks of the Kern River, CA | 14.0 | 2.0 | 2.0 | 4.0 | 3.5 |
| John Day, OR (Clarno to Cottonwood) | 69.0 | 5.0 | 4.0 | 20.0 | 3.5 |
| Dolores, CO (Slickrock to Bedrock) | 50.0 | 3.0 | 5.0 | 15.0 | 3.3 |
| Grand Canyon (current summer peak) | 226.0 | 18 | 9.0 | 70.0 | 3.2 |
| San Juan, UT (Mex. Hat to Lake Powell) | 57.0 | 4.0 | 5.0 | 20.0 | 2.9 |
| Upper Gulkana, AK (Pax.-Sourdough) | 47.0 | 4.0 | 5.0 | 20.0 | 2.4 |
| Middle Fork Salmon, ID | 97.0 | 6.0 | 7.0 | 42.0 | 2.3 |
| Gray/Desolation on Green River, UT | 84.0 | 6.0 | 6.5 | 39.0 | 2.2 |
| Hells Canyon, OR/ID (dam to Pittsburg) | 32.0 | 3.0 | 5.0 | 15.0 | 2.1 |
| Rio Chama, NM (weekends, July + Aug) | 32.0 | 2.0 | 8.0 | 16.0 | 2.0 |
| Main Salmon, ID (wild section) | 79.0 | 5.0 | 8.0 | 40.0 | 2.0 |
| Dolores, CO (Bradfield to Slickrock) | 47.0 | 3.0 | 8.0 | 24.0 | 2.0 |
| San Juan, UT (Sand Is. to Mexican Hat) | 27.0 | 2.0 | 7.0 | 14.0 | 1.9 |
| Lower Salmon, ID (avg. in high season) | 74.0 | 4.7 | 8.4 | 39.5 | 1.9 |
| Smith, MT | 59.0 | 4.4 | 8.0 | 35.2 | 1.7 |
| Deschutes, OR (Warm Springs to L. Gate) | 41.0 | 3.0 | 10.0 | 30.0 | 1.4 |
| Tuolumne, CA | 16.0 | 2.0 | 6.0 | 12.0 | 1.3 |
| Lower Salmon, ID (peak periods) | 74.0 | 5.0 | 15.0 | 75.0 | 1.0 |
| Rogue, OR (wild section) | 34.0 | 3.0 | 12.0 | 36.0 | 0.9 |
| Median (without Grand Canyon) | | | 5.0 | | 2.3 |

average two to three miles between trips, while the current Grand Canyon summer average is closer to four. While Grand Canyon has higher densities than the Tatshenshini or Selway (both with very low launch levels), it has lower densities than the Middle Fork Salmon, Main Salmon, Green through Desolation, Hells Canyon, Rogue, and Lower Salmon. A comparison of campsite frequency on thirteen of these rivers (not all provided camp information) shows they average 0.7 to 1.3 camps per mile, which is similar to Grand Canyon (at 1.0 per mile). Overall, these findings suggest that Grand Canyon is likely to have similar or lower campsite occupancy rates and camp competition than most comparable rivers; albeit, these general comparisons simplify camp competition issues in Grand Canyon.

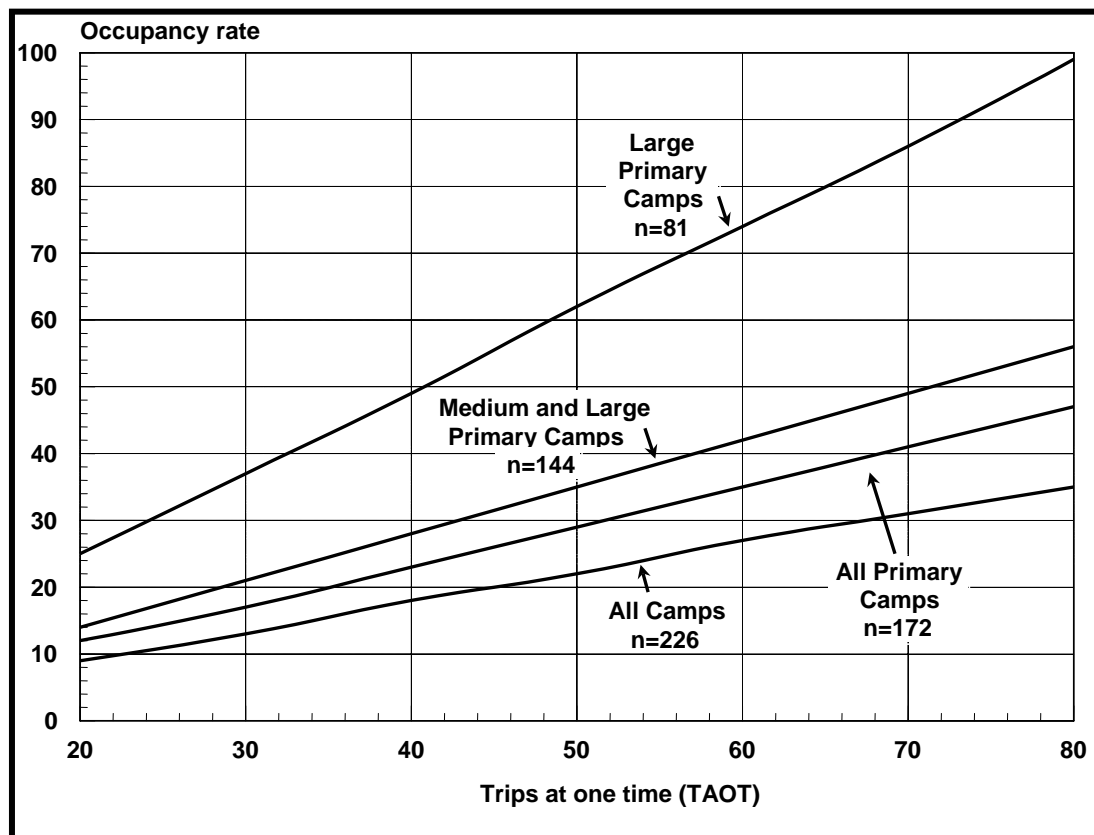
Higher trip densities (and fewer camps) occur in “bottleneck” areas near attraction sites or exchange points. In addition, some Grand Canyon trips can only use large sites with good access for large boats, which affects the “usable” campsite density. With some beaches getting smaller due to Glen Canyon Dam, camp competition may increase over time

regardless of alternative (see “Camps and Beaches” section in Chapter 3 under “Visitor Use and Experience”). Camp competition may have direct or indirect short- or long-term, localized, adverse or beneficial impacts to visitor experience.

Camp Competition and Use Levels

Figure G-3 partially addresses these issues, showing the relationship between trips at one time and camp occupancy rates in Grand Canyon for different categories of camps (assuming all “more desirable” camps are occupied first). Occupancy levels of 100% would mean every camp was being used. The number of camps in each category is based on inventory data from 1991; since that time, other studies (but not full inventories) suggest the number and size of camps has decreased.

FIGURE G-3: RELATIONSHIP BETWEEN TRIPS AT ONE TIME AND CAMPSITE OCCUPANCY RATES



Note: For different categories of camps based on 1991 inventory). Low water camps excluded

Results show that nearly all the large primary camps and about half of the medium and large primary camps would be occupied if trips at one time approached 70 (current summer peaks). At typical current summer levels, 55 trips at one time would produce occupancy rates of about 70% of large primary camps, and 40% of medium and large primary camps, but only about 25% of all camps. Table G-3 shows current TAOT density in all seasons.

**TABLE G-3: NUMBER OF TRIPS AT ONE TIME
IN SUMMER, FALL, WINTER, AND SPRING**

| | Current Situation |
|------------------------|--------------------------|
| Summer (June average) | 57 |
| Summer (peaks) | 70 |
| Spring (March average) | 16 |
| Spring (April average) | 31 |
| Fall (Sept. average) | 54 |
| Fall (October average) | 38 |
| Winter (Jan. average) | 10 |

One implication from these findings is that somewhat smaller group sizes are likely to substantially reduce camp competition impacts. If all groups were small enough to occupy medium-sized camps (13 to 24 people), campsite occupancy rates would be cut nearly in half compared to having all groups competing for large camps. About 40% of the camps in Grand Canyon are medium-sized.

In contrast, dramatic reductions in group sizes are not likely to substantially reduce camp competition further. Less than 20% of camps in Grand Canyon are considered “small” (12 or fewer people), so even if all trips were able to use these, gains in occupancy rates are marginal. Several new alternatives provide access for small group noncommercial trips (< 8 people) that would be required to use small and medium sites (and thus not exacerbate competition for larger sites). These data also suggest that small site capacity is relatively limited; to avoid competition problems for these small sites, “small group trips at one time” should probably not exceed 20 to 30% of total trips at one time (about 1 launch per day).

Launch and Takeout Congestion

Launch and take-out congestion refers to the quantity of people, boats, and gear at put-in or take-out sites, and the way it affects efficient use of launch facilities (e.g., boat ramps, parking, and education and interpretation programs). While people and boats contribute to launch congestion, the number of people is probably the key indicator and the focus of analysis in this DEIS. In Grand Canyon, the critical launch areas are Lees Ferry, Diamond Creek, and Lake Mead (previously Pearce Ferry; currently South Cove). Launch and take-out congestion may have direct or indirect, short-term, localized, adverse or beneficial impacts on visitor experience.

Launch and take-out congestion has been examined in some river studies, but it appears less important than river encounters or camp competition, particularly on multi-day trips (Whittaker 1993). Users are probably interested in efficient facilities that can handle the expected volume of use, but a small proportion of the trip is spent at launches, so some short-lived congestion is probably tolerable and has only minor effects on overall experiences.

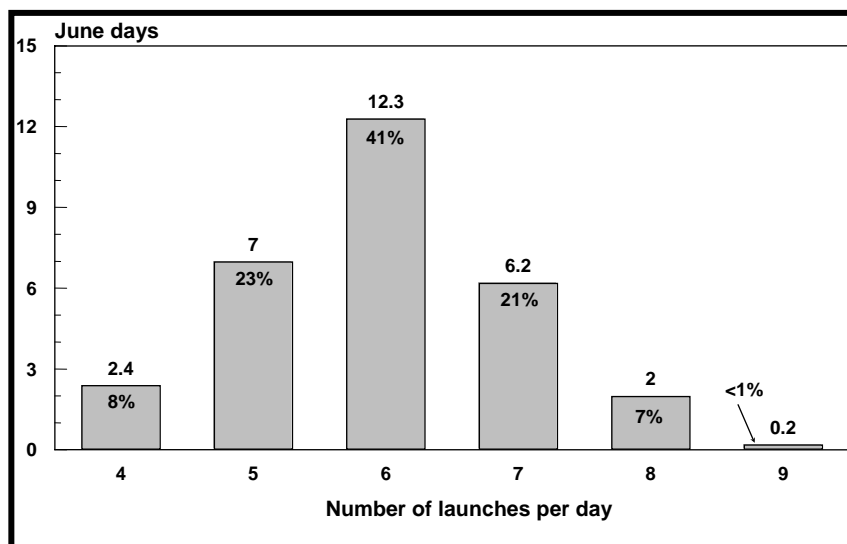
There is little specific comparative data on launch levels, but a cursory review of peak season launch rates on several multi-day use rivers (including several that are in designated Wilderness) is instructive. In general, the current number of people launching at Lees Ferry in summer is much higher than some multi-day rivers (e.g., Selway, Tatshashini-Alsek), slightly higher than others (Hells Canyon, Cataract Canyon, Desolation/Gray, the San Juan, or the

Yampa), but comparable to the Middle Fork Salmon, Main Salmon, Rogue, and Lower Salmon.

Use patterns generally have a direct relationship with launch congestion, although facility size and design are also important. In addition, the timing of trip put-ins and take-outs can create substantial congestion for a few hours even if overall daily launch levels are acceptable. Factors that can exacerbate congestion are the number of people and boats, the efficiency of users, and the efficiency of their equipment. In Grand Canyon, oar trips are probably less efficient than motor trips and noncommercial trips are less efficient than commercial trips.

Another major influence on launch and take-out congestion in Grand Canyon is the distribution of launches through the week. Under current management, there are limits on the number of people launching per day, but no limits on launches because it is a user-day based system. The resulting uneven launch patterns are shown in Figure G-4, based on June data from 1998-2002. This figure shows that nearly 30% of days had seven or more launches, while a similar percentage had five or fewer launches. Congestion impacts are more maintaining the same overall use level.

FIGURE G-4: UNEVEN LAUNCH PATTERNS: LAUNCHES PER DAY IN JUNE 1998-2002



Group Size

Group size refers to the total people on a trip (including commercial crew) and is an important component of river trips. The size on one's own group and the size of groups one encounters affect opportunities for solitude and the character of wilderness trips, as well as logistics and dynamics within the group. People spend 24 hours a day with their own group, so "own group size" is arguably more important than occasional encounters with large groups. In either case, group size limits can directly manage these impacts. Group size has direct, short- or long-term, regional, adverse or beneficial impacts on visitor experience.

A review of group size limits on 25 multi-day river systems in the west (River Management Society, 2003) shows that one-third have limits at 16 and three-quarters have limits of 26 or less. Only five rivers (parts of the Rio Grande in Big Bend, Klamath, Lower-Salmon, Main Salmon, and commercial groups on the Middle Fork Salmon) have limits at 30, and only one (Cataract Canyon) has a limit of 40. In Grand Canyon, commercial group size is 36 passengers or up to 46 with crew.

Data from the 1998 boater survey offers compelling evidence that Grand Canyon River users prefer to be part of and meet smaller rather than larger groups (Hall & Shelby, 2000). The following summarizes findings based on questions that asked about being in small (0-20), medium (21-30), or large (31-40) groups and form the list of assumptions used for group size:

- Among commercial motorized passengers, 83% prefer to be in small or medium groups (with 56% preferring to be in small groups). Less than 4% prefer to be in large groups and only 13% report it makes no difference.
- Among commercial oar passengers, 98% prefer to be in small or medium groups (81% prefer to be in small groups).
- Private boaters unanimously prefer to be in small groups.
- Among guides, 88% prefer to be in small or medium groups (66% prefer small groups).
- Even among people who were in large groups themselves, 83% prefer to be in small or medium groups (48% prefer to be in small groups). Only 6% preferred to be in large groups and 11% reported that it makes no difference.
- The 1998 boater survey asked boaters about preferences for meeting other groups of different sizes. Results were similar to the “own group preferences” above.
- The 1998 survey also asked boaters specifically about their opinions of group size limits and results are consistent with their preferences for own groups size or meeting other groups. Preferences for group size limits are summarized in Table G-4 for different user groups.

TABLE G-4: PREFERENCES FOR GROUP SIZE LIMITS

| Group Size Preference | Commercial Motor | Commercial Oar | Noncommercial | Guides |
|---------------------------------------|------------------|----------------|---------------|--------|
| Group size should be 20 or less (%) | 31 | 37 | 74 | 17 |
| Group size should be 30 or less (%) | 69 | 88 | 98 | 75 |
| Group size should be 31 or higher (%) | 31 | 12 | 2 | 25 |
| Preferred group size limit (average) | 28.8 | 25.5 | 20.0 | 28.5 |

Source: 1998 study.

Assuming standard passenger-to-crew ratios on commercial trips and group size categories, the percentages of trips in different size categories under current management are given in Table G-5. In general, about one fifth of all current trips have a large (31 to 40) or very large (over 40) group size. Data show that most Grand Canyon boaters do not want to be part of or meet these large groups.

TABLE G-5: PERCENTAGE OF LAUNCHES OF DIFFERENT SIZES (INCLUDING CREW) IN 2002

| Group Size Percents | Commercial Motor | Commercial Oar | Noncommercial | All trips |
|--------------------------------|-------------------------|-----------------------|----------------------|------------------|
| Very small groups (10 or less) | 2 | 1 | 23 | 8 |
| Small groups (11 to 20) | 34 | 12 | 77 | 42 |
| Medium groups (21-30) | 27 | 80 | 0 | 29 |
| Large groups (31-40) | 35 | 7 | 0 | 20 |
| Very large groups (41 or more) | 2 | 0 | 0 | 1 |

Trip Length

Trip length refers to regulations on maximum trip lengths; it has major effects on trips. Longer trips allow greater opportunities to explore the canyon, hike, visit attraction sites, or have an “unhurried” trip. Shorter trips provide less time in the canyon, although this may fit with some users’ limited vacation time or preferences for shorter trips. The quality of either trip can be high, but the nature of each may be fundamentally different. Trip length has direct or indirect, long-term, regional, adverse or beneficial impacts on visitor experience.

For many users, a long trip appears to be important and a distinguishing feature of the Grand Canyon. Boaters were asked to rate Grand Canyon trips on 12 general attributes compared to other rivers, and the “length of time traveling through an undisturbed environment” was the third highest ranked (just behind geology and scenery; just ahead of whitewater as indicated in the “Recreation Values” section of Chapter 3 under “Visitor Use and Experience”). Nearly one-third of commercial passengers and 51% of noncommercial users felt their trip was too short. Most noncommercial boaters prefer trip lengths of 16 to 18 days from Lees Ferry to Diamond Creek (18 is the current summer trip length limit and most trips are close to that limit). It is likely that many noncommercial users would take longer trips if allowed and some choose trips during shoulder or winter seasons because longer trips are allowed then.

Most commercial passengers have no previous experience in Grand Canyon, relying on options and information from outfitters when choosing trip lengths. Most motor trips are six to eight days and most oar trips are 12 to 14 days; however, commercial motorized trips far out-number commercial non-motorized trips. Under a user-day based limit system, there is a general incentive for outfitters to offer shorter commercial trips, but some longer trip options remain available from some outfitters. Longer trips allow more time in the canyon, but increased impacts related to trips at one time related and decreased access. Shortening trip lengths is one way to produce higher numbers of trips while reducing “at one time” impacts.

Discretionary Time, Exploration Impacts, and Personal Benefits

Discretionary time refers to the free time on Grand Canyon river trips that is not spent on logistics (e.g., packing, rigging, preparing meals, etc.), sleep, or travel on the river. Although it is related to trip length, discretionary time is also influenced by other factors, such as daylight hours (which change by season) and type of trip.

Because discretionary time is a new tool developed for this DEIS, it is potentially important in two ways. First, it may help suggest relationships between use levels and certain biophysical or cultural impacts (see natural and cultural resource sections for impact analyses). Second, discretionary time is a useful indicator of trip quality. Researchers have catalogued a long list of psychological benefits from outdoor recreation experiences (Driver, Brown & Peterson, 1991; Crystal & Harris, 1995), several of which are probably related to the time people have for exploration activities different from down-river travel and logistics. More discretionary time may translate into improved opportunities to appreciate nature or cultural resources; experience a sense of freedom or adventure; develop new skills, self-reliance, and competence; or engage in personal or spiritual growth.

The NPS model integrates trip types, use patterns, and trip length information with the number of daylight hours (9.5 in winter to 14.5 in summer), while making assumptions about the amount of time different trip types spend on the river, sleeping, or doing logistical activities. Variables used in the model are listed below; specific information about the model and additional adjustments made during calculations are documented in Appendix XX (NPS, 2004):

Per trip time (subtracted from total trip length):

- Put-in (varies by commercial and noncommercial)
- Takeout (varies by commercial and noncommercial)
- On river (varies by commercial motor, commercial oar, and noncommercial)
- Scouting rapids (varies by commercial motor, commercial oar, and noncommercial)

Per day time (subtracted per day over total trip length):

- Loading and unloading
- Meals
- Camp set-up
- Hygiene

Albeit a new tool to be used for relative comparisons between groups or alternatives, in general the discretionary time model suggests several hypotheses about people's free time on river trips that form the basis of assumptions used for visitor experience.

- Noncommercial trips may be less efficient at daily and per trip logistical tasks because they generally view their trip as leisure time and often conduct logistics in a more leisurely pace.
- The number of daylight hours affects the amount of time groups can spend exploring the canyon.
- If trip lengths were equal, more efficient commercial trips would have more discretionary time than noncommercial trips; because most commercial trips are substantially shorter, there are smaller differences between the two.

- Noncommercial trips are longer and spend more time at attraction sites and camps (Hall & Shelby, 1998).

Aggregate discretionary time is given in each Lees Ferry Alternative and shows how discretionary time varies considerably by alternative, and the differences are not necessarily driven by user-day total (e.g., all of the alternatives have similar number of commercial user-days, but some produce substantially more discretionary hours in the commercial sectors). In this analysis, discretionary time has a direct or indirect, long-term, regional, adverse or beneficial impact on visitor experience.

Discretionary time can be a useful model for this social impact analysis; however, at least three substantial information gaps limit its value.

First, the relationship between trip length and discretionary time is unknown. While people on longer trips obviously have more total time in the canyon, it is unknown how this translates into the amount of discretionary time. For example, people on longer trips may spend more time on logistics (cooking more elaborate meals, taking more time to scout rapids, or set up camps).

Second, people's activities during discretionary time are unknown. More discretionary time provides the opportunity to hike trails or swim in tributaries, but some people may use that time to relax in camp, prepare gourmet meals, or socialize. Each of these pursuits may provide different personal benefits and have different impacts.

Third, the relationship between discretionary time activities and adverse impacts or personal benefits is unknown. A group that spends more time hiking does not necessarily cause more "exploration impacts." For example, a long hike employing Leave No Trace ethics (e.g., staying on the trail, avoiding wildlife disturbance, and not disturbing cultural sites) may have less impact than a short hike that is less careful and is supported in much of the biophysical impact literature (Cole, 1994; Cole, 2000).

Non-Motorized Opportunities

Conflicts about motorized and non-motorized use are a major planning issue. Although several variables may be relevant (see below), the fundamental decisions in this DEIS focus on the length of non-motorized use periods for the alternatives. The relevant indicators are the numbers and percent of probable trips (and people who get to take them) in those non-motorized periods. Non-motorized opportunities may have direct or indirect, short- or long-term, regional, adverse or beneficial impacts on visitor experience.

Conflicts between motorized and non-motorized use are well-documented in the recreation literature (Lucas, 1964; Jacob & Schreyer, 1980; Shelby, 1980; Adelman et al., 1982; Jackson & Wong, 1982; Kuss et al., 1990). Research shows antipathy from non-motorized users toward motorized use in many settings, particularly wilderness-like settings. This antipathy is often one-sided, and it may have a value-based component that is independent of actual encounters with motorized users (i.e., social conflict; see Vaske et al., 1995). The central issue of the conflict between motorized and non-motorized use is the nature of contrasting

experiences (Shelby, 1980). Motorized use has been an issue in Grand Canyon since the exponential growth in use in the 1960s (see Chapter 1 – Purpose & Need of this DEIS for background).

In 1975, a group of commercial passengers took experimental Grand Canyon “combination” motor-oar trips. Most participants preferred oar travel because they perceived a slower, more relaxed pace; smaller more comfortable social groupings; and enhanced sensitivity to the natural environment. These perceptions related to objective differences (such as trip length, party size, and boat configuration) between oar and motor trips. Overall, 92% reported that oar trips better enabled them to “experience the Grand Canyon environment;” this is among the most compelling findings in the recreation research literature on conflicts or social impacts.

When asked about preferences for meeting motor or oar trips, 84% of commercial oar and 93% of noncommercial users prefer to encounter oar trips and only 1% preferred to meet motor trips (the remainder said it made no difference to them). In contrast, 13% of motor passengers prefer to meet oar trips, 6% prefer to meet other motor trips, but 81% said it “makes no difference.” This type of “asymmetric antipathy” is common in use conflicts, particularly those involving motorized use.

The asymmetry is further illustrated in results from a trade-off question. About 80% of motor users said they would prefer to meet one trip of 35 people on 2 motorboats that passes quickly, compared to a trip of 35 people on 8 oar boats that goes by more slowly. Among oar users the finding was reversed, with 80% preferring the longer contact with the multi-boat oar trip.

Without linking the motorized use issue to legal definitions of wilderness, 1998 data also show that most oar users (85% of noncommercial users and 74% of commercial oar passengers) believe the canyon would be “more of a wilderness if motor travel were banned.” Less than half the guides (46%) and only a quarter of motorized users felt the same. Wilderness concepts are multi-faceted and defy simple characterizations (Nash, 1982; Oelschlaeger, 1991); the motor/non-motor issue often-times is viewed with a social values perspective and thereby, cannot be resolved in this DEIS.

Whitmore Helicopter Activity

Nearly 11,000 commercial passengers per year currently put-in or take-out at the Whitmore helipad (RM187) via helicopter exchanges from the rim; noncommercial boaters hardly ever use this access point. Shuttles affect the people who use them and the trips that encounter them. This use also may be part of a more profound social values conflict about the appropriateness of helicopters in the Canyon, regardless of how many people encounter them.

Under current management, uneven launch patterns create distinct patterns of helicopter use at Whitmore, with the greatest use in the summer and on certain days of the week. Figure G-5 shows the number of days per month with Whitmore helicopter activity, along with the number of river trips involved per day. Figure G-6 shows the average number of river trips participating in shuttles by day of the week (from June and July 2002 data).

FIGURE G-5: WHITMORE HELICOPTER ACTIVITY, 2002
Days per Month and Number of Trips per Day

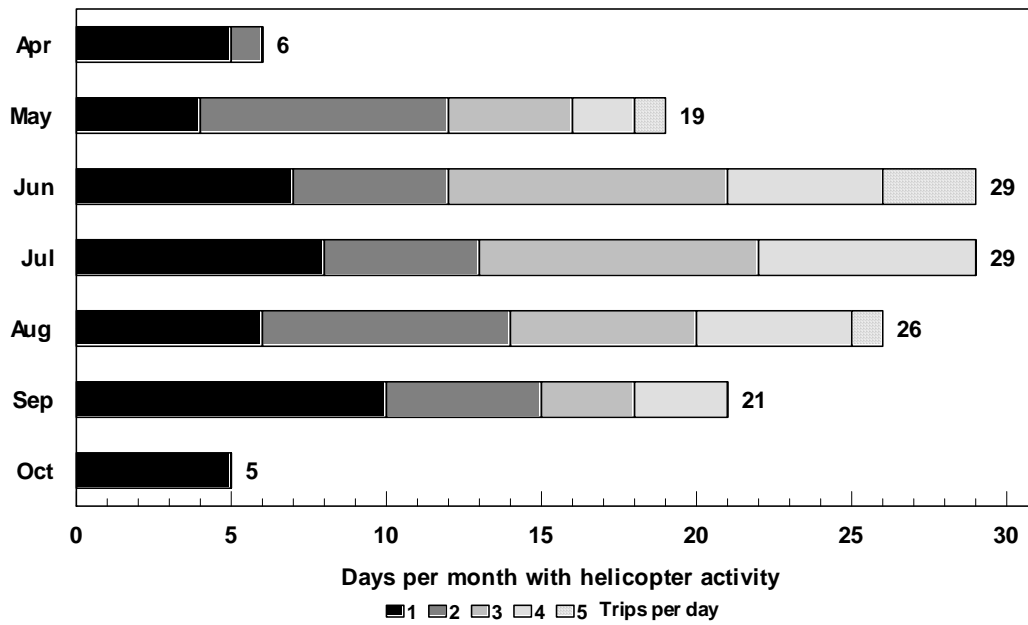
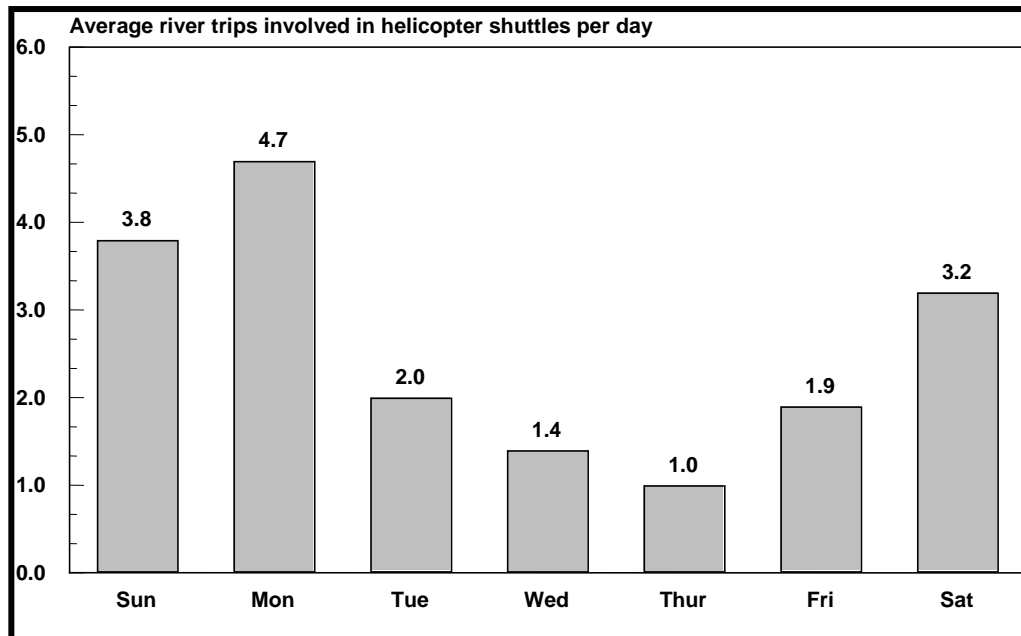


FIGURE G-6: RIVER TRIPS INVOLVED IN HELICOPTER SHUTTLES BY DAY OF THE WEEK



SOURCE: June and July, 2002 data.

Table G-6 provides additional statistics about the percent of days with Whitmore helicopter use and the percent that involve three or more trips per day. In summer months, 84% of days have some helicopter activity and 42% have three or more river trips participating per day. In June and July, 94% of days have some activity and 52% have three or more trips. Spring helicopter activity levels are lower, with no activity in March and 20% of days in April (most involving only one trip per day). In fall, about 40% of days have some helicopter activity.

TABLE G-6: WHITMORE HELICOPTER ACTIVITY, 2002

| Months and Seasons of Helicopter Activity | Percentage of Days (any activity) | Percentage of Days (3 or more trips) | Average Number of River Trips Involved per Day |
|---|-----------------------------------|--------------------------------------|--|
| March | 0 | 0 | 0.0 |
| April | 20 | 0 | 0.2 |
| May | 61 | 23 | 1.5 |
| June | 97 | 57 | 2.7 |
| July | 94 | 52 | 2.4 |
| August | 84 | 39 | 2.1 |
| September | 70 | 20 | 1.4 |
| October | 16 | 0 | 0.2 |
| Spring | 10 | 0 | 0.1 |
| Summer | 84 | 42 | 2.1 |
| Fall | 43 | 10 | 0.8 |

Whitmore helicopter shuttles have several potential impacts on trips. Although more localized than impacts from motorized rafting use or aircraft overflights in general, low altitude helicopters using Whitmore are louder and contrast sharply with other components of Grand Canyon River experiences. Perceived adverse impacts from helicopters may include:

- Noise
- Physical impacts (downwash from rotors may blow sand or gear around)
- Visual impacts (seeing mechanized use after a week or more of being in a primitive and undeveloped setting)
- Congestion at Whitmore helipad (particularly for trip passengers waiting for helicopter exchanges to be completed)
- Perceived safety risks from low flying aircraft
- Camp competition for sites near the helipad or “trip scheduling” changes to use or avoid helicopters
- Creation of an “artificial” end to the trip, 39 miles upstream of Diamond Creek

As with motorized/non-motorized conflicts in general, antipathy regarding helicopter use is probably asymmetrical, with those not using helicopters being the sensitive group. Most people participating in helicopter shuttles probably view them as a “feature” of their trips, and data suggest that most users who take scenic helicopter trips enjoy the views of the canyon they provide (NPS 1995).

As with motorized boating, conflict over helicopter use is likely to have a strong “value-based” component. Based on public comments, some people feel helicopters are inappropriate

for the Grand Canyon even if few people encounter them or noise impacts are limited by improved technologies or temporal zoning.

Helicopter shuttles may provide some beneficial impacts, including in-canyon “flight-seeing” opportunities for helicopter passengers, decreased congestion at other take-outs, and a variety of economic benefits to commercial outfitters; aircraft concessions, Bar-10 Ranch, and the Hualapai Nation (see Soundscapes and Socioeconomic sections for specific impact analyses).

Many studies have examined noise impacts from aircraft, although few have focused on backcountry settings (Gramann, 1999). Several studies are specific to Grand Canyon, although they focus on general overflight impacts, not Whitmore. In general, aircraft noise impact studies use three different approaches (Gramann, 1999). Psychological approaches focus on visitor evaluations without considering physical sound measurements; acoustical approaches quantify physical sound levels relative to ambient sound; and psycho-acoustical approaches combine non-site evaluations with physical measurements (see Natural Soundscape sections of this DEIS for further information). Assumptions used for assessing aircraft noise impacts on visitor experience include:

- Visitor characteristics affect evaluations of aircraft noise. There is great sensitivity to aircraft noise by backcountry vs. front country users, repeat vs. first-time users, and small vs. larger groups (HBRS/HMMR, 1993; Anderson et al., 1994; NPS, 1995). Additional characteristics are likely to distinguish more and less sensitive visitors.
- Among river users, sensitivity to aircraft noise is greater for oar vs. motor users (HBRS/HMMR, 1993). Possible explanations focus on desired experiences, higher noise levels from raft motors, and higher “self-noise” at land sites (because motor groups tend to be larger).
- In Grand Canyon, 88% of oar and 74% of motor river users reported hearing aircraft in general (not specific to Whitmore use). Among oar users, 52% thought aircraft noise interfered with “natural quiet,” and 38% reported noise levels were moderately to extremely annoying. Among motor users, 22% felt noise interfered with natural quiet and 14% reported it was annoying (HBRS/HMMR, 1993).
- There is strong support among river users for management actions to reduce or eliminate aircraft noise impacts, with about 70% supporting defined aircraft use areas, about 66% supporting time of day restrictions, and about half supporting day of the week restrictions (HBRS/HMMR, 1993). Among oar users, 56% support seasonal restrictions; among motor users, 43% support seasonal restrictions. For all the other actions, there was less support among motor passengers than oar passengers.
- Noise levels may be more objectionable at specific locations (e.g., attraction sites, reaches of the river without rapids, or similar places with low ambient sound) and at different times of the day (e.g., at night while sleeping, in early morning).

Specific impacts from Whitmore helicopter activity are characterized in the following categories in the “Visitor Use and Experience” section of this document:

- *Close Encounters* — These are low-altitude encounters with helicopters as they land or take-off at the river or while they are active at the helipad. Noise levels are

substantially higher than distant encounters with scenic overflights or high altitude commercial aircraft, and majorities would probably rate them “moderately annoying” or worse. These encounters are also probably responsible for occasional physical impacts and perceptions of safety risks (as described in some public comments).

Despite their potential impact, close encounters occur less frequently than distant encounters. For close encounters to occur, a river trip must be near the helipad during active periods. Under current management, active helicopter use is generally under five hours per day in peak summer months, and often less. Some river trips may also avoid these encounters by scheduling to pass the helipad in late afternoon or on lower use days. Close encounters have direct, short-term, localized, adverse impacts on visitor experience.

- *Distant Encounters* — These involve more distant visual or noise impacts from helicopters flying from the helipad to the rim, rather than close encounters near the landing site. Impacts are likely to vary depending on flight patterns, wind, terrain, or other factors that affect the distance between boaters and helicopters. At a down-river speed of 5 mph, an oar trip is probably within the “distant encounter zone” of Whitmore helicopters for less than two hours (assuming they camp more than 3 or 4 miles away from the helipad). Motor trips are probably within the distant encounter zone for half that time, because self-noise levels are higher and they travel faster.

Distant encounters are likely to have smaller impacts on passing boaters than close encounters, but they have greater impacts than overflights or commercial aircraft. These impacts are incompatible with the concept of “natural quiet” (see Natural Soundscape section) or a “wilderness-like” experience. Distant encounters have indirect, short-term, localized, adverse impacts on visitor experience.

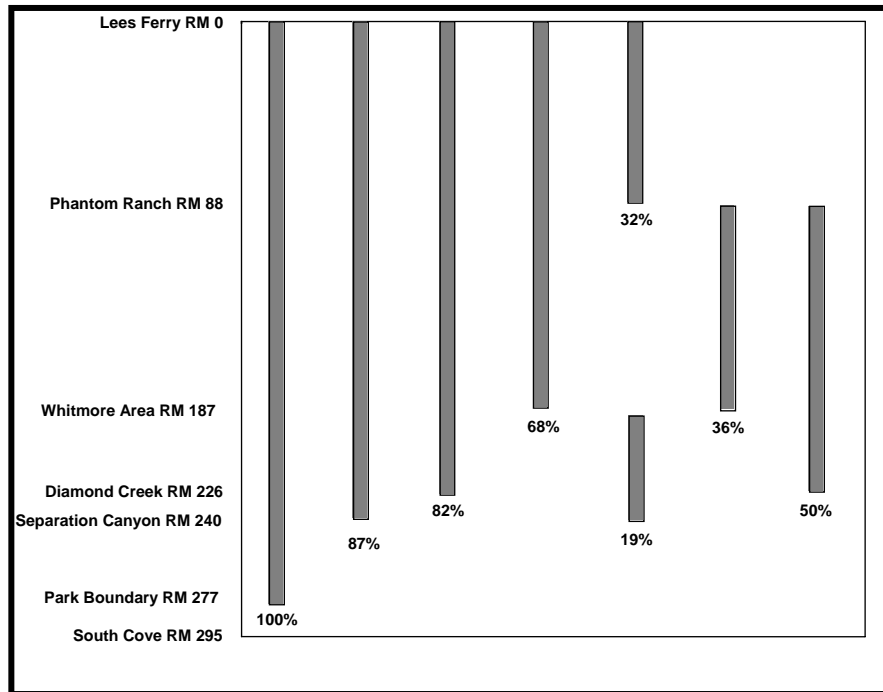
- *Contrasting Experience Effects for Helicopter Exchange Passengers* — A third impact may occur for users involved in helicopter exchanges. Helicopter use is advertised as a trip feature that provides views of the canyon different from those on the river, and a study of scenic overflight passengers suggests that most enjoy them and would recommend them to others (NPS, 1995). But helicopter exchanges are a substantial contrast to being on the river and they may have effects on overall experiences.

The contrast is probably greatest for passengers on long oar trips (although only about 11% of oar trips are involved in Whitmore exchanges), and smallest for those on short (5 day) motor trips (particularly those who joined short trips at Phantom Ranch). It is likely to be exacerbated by congestion at the helipad, which varies by season and day of the week under current management.

- *“Shortening” the Grand Canyon River Trip Experience* — The Colorado River in Grand Canyon provides one of the longest river trips in the Lower 48 states. Geologically and historically, the Grand Canyon starts at Lees Ferry and ends at Grand Cliffs (the current Grand Canyon National Park boundary). For passengers boating from Lees Ferry to Whitmore, the river trip is only 187 miles long, about 32% shorter than the entire canyon (see Figure G-7). The effects are compounded for passengers who start their trips at Phantom Ranch after hiking in.

For passengers who put-in at Whitmore, trips include just 53 miles on the river (Whitmore to Separation Canyon). Many of these trips conclude with a jetboat component, their river trip is 81% shorter than a trip through the entire canyon.

**FIGURE G-7: COMMON TRIP LENGTHS AND THE “SHORTENING” OF GRAND CANYON
(Percentages of Total Length)**



- Sensitive groups*** — Helicopter exchange impacts are likely to be more objectionable to noncommercial vs. commercial oar users, and more objectionable to oar users vs. motor users. The longer a person has been on a trip or away from close contact with mechanized sound, the more intrusive helicopter impacts are likely to be. Noncommercial users may be particularly sensitive to these impacts because they are associated with commercial user, which may interact with their evaluations of motorized rafts and access issues.

Under current management, even peak season trips experience helicopter exchange impacts for a relatively small proportion of their total time in the canyon (probably about 1 to 2% of the total hours). However, the length, frequency, or duration of these encounters may not be as important as the simple fact of their occurrence, particularly for those who have a value-based objection to helicopter use in backcountry settings. The contrast between helicopter use and other components of the Grand Canyon river trip experience is so great that a single encounter may have substantial effects on many users' experiences.

Encounters between River Users and Hikers

From a river runner perspective, encounters between river users and hikers happen relatively infrequently. On average, river users only see a hiking group about one day out of four (Hall & Shelby, 2000). More importantly, hikers and river users have these encounters at specific locations, and river users can limit these encounters by spending less time at those attraction sites or camps. Hiker-river encounters occur most often near Phantom Ranch; they occur occasionally at points where less-used trails reach the river (e.g., Deer Creek, Hance, Granite, Tapeats, and Hermit).

From a hiker perspective, encounters may be more common and obtrusive. A hiker who camps or spends time along the river in the summer may see 5 to 7 river groups per day, which is probably more than the number of other hiking groups they encounter (except in the Bright Angel / Kaibab corridor). Perhaps more importantly, hikers may arrive at the river late in the day seeking a beach camp only to find it is already occupied by a river party (especially at Hance, Granite, Tapeats, or Hermit). Under current management, the problem is relatively small because the prime hiking seasons are in spring and fall, while the primary river season is in the summer. Generally, encounters between river users and hikers may have direct or indirect, short-term, localized, adverse or beneficial impacts on visitor experience.

Phantom Ranch Exchanges

Under current management, 2,071 users leave trips at Phantom Ranch and 1,981 replace them after hiking in (see Chapter 3, “Visitor Use and Experience”). Most of these exchanges occur on commercial oar trips (about 1,400 and over half of all exchanges), although they are also common on motor trips (about 800 exchanges and about one third of all exchanges). Fewer than 300 exchanges currently occur on noncommercial trips (just over 10% of all exchanges).

The social dynamics of having some proportion of users leave or join a trip are not trivial. Those taking the longer trip may not invest effort in meeting or getting to know passengers that are leaving sooner, and the effort involved in meeting and dealing with new arrivals is also substantial. For new arrivals, they face integration into a social group that may have already formed friendships and have some shared history. For guides, educational and interpretive information must be conveyed to the new set of passengers, which may be repetitive to the original passengers and diminishes opportunities for more in-depth information.

A more important management issue focuses on the hiking challenges for Phantom exchange passengers. The relative difficulty of the hike depends on individual fitness, skill, and experience levels, and outfitters probably try to discourage the obviously unqualified. However, it is not known how rigorously outfitters screen exchange passengers or the degree to which they provide accurate information about the difficulty of the hike. While many outfitters encourage their passengers to take the hike seriously, under current regulations guides and outfitters are generally not responsible for their passengers when they are not on the river trip, which can potentially be a health and safety risk to their passengers. Phantom Ranch Exchanges may have direct or indirect, short-term, localized adverse or beneficial impacts on visitor experience.

APPENDIX H: USER DISCRETIONARY TIME

User Discretionary Time Model

Colorado River Management Plan

Carl Bowman

Air Quality Specialist, Grand Canyon N.P.

Purpose

The User Discretionary Time ("UDT") model is designed to assist evaluation of different management alternatives for recreational use on the Colorado River in Grand Canyon National Park.

The UTD model uses the number of daylight hours available in two-week increments through the year as the basis for time calculations. Model users may select daylight or three types of twilight as the basis for discretionary time calculations on the "UDT Variables" worksheet.

From available daylight hours, various tasks associated with Colorado River trips are subtracted.

There are two types of tasks, those that occur on a "per trip" basis (for example, downriver travel), and those that occur on a "daily" basis (for example, eating a meal).

"Trip Tasks" are subtracted once per trip per user (trips and users are based on launches from Lees Ferry)

"Daily Tasks" are subtracted once per user-day from all users. There are two types of Daily Tasks: those whose time commitment remains constant throughout the year, and those whose time commitment can vary by month.

Constant Daily Tasks form the basis of the Daily Task variable.

Daily Tasks whose time commitment varies by month are then added or subtracted from the Constant Daily Tasks to derive the final Daily Task time commitment by month.

Both Trip and Daily tasks can have unique hour values for each of the four trip types analyzed in the CRMP, although the same number of hours can be used for some or all of the types:

Commercial Motor

Commercial Non-motor

Non-commercial Standard

Non-commercial Small

After these subtractions, the remaining time is assumed to be available at the River-users' discretion (hiking, photography, etc.), thus the name "user discretionary time."

Working the Spreadsheet

The workbook is designed to allow changes on one worksheet, "UDT Variables," to cascade through the entire workbook (including the graphs). There are 5 categories of variables the user can enter (each in its own colored box) on that sheet:

Trip Tasks: Hours Used (river running, put-in, etc.)

Daily Tasks: Hours Used Year-round (eating, hygiene, etc.)

Monthly Variables (month-specific tasks that add or subtract UDT)

New User Days (removing days from average trip length for take-out)

Select Light Period (sunrise/sunset, 3 types of twilight)

The "cascading" allows users to analyze the effect of different variables and the time assigned to them on the total UDT available to specific trip types under different management alternatives.

Numeric Basis

This workbook builds on a CRMP master workbook where such inputs as probable user days and probable launches are calculated.

If the CRMP master workbook changes, this workbook can be modified by pasting the appropriate new values into the following worksheets:

- Basic Info

- ProbLaunch

- ProbUserDays

The UDT model uses a newly calculated user-day statistic that subtracts one day per trip per person to account for take-out.

- This subtracted day can be adjusted on the UDT Variables worksheet.

- This day is subtracted from user days, *not* from daylight hours.



Variables for Calculating User Discretionary Time:

There are 5 categories (colored boxes) in which to enter variables (shown as red numbers)!

| | Commercial | | Private | | |
|------------------------|------------|-----------|----------|----------|--|
| | Motor | Non-motor | Regular | Small | Assumptions |
| Trip Tasks: Hours Used | | | | | |
| Put-in | 4 | 4 | 6 | 6 | |
| Exchanges | 0 | 0 | 0 | 0 | Although exchanges occur, resource use occurs during the interval making it essentially "UDT." |
| Take-out | 0 | 0 | 0 | 0 | See "New User Days" below |
| River "drift" | 37.5 | 56.25 | 64.28571 | 64.28571 | 225 miles 4 mph for commercial non-motor 3.5 mph for private non-motor 6 mph for motor |
| Scout Rapids | 2.25 | 5.25 | 11.25 | 11.25 | 0.75 hour/rapid scouted 3 Rapids scouted/commercial motor 7 Rapids scouted/commercial non-motor 15 Rapids scouted/private |
| First day Credits | -1.5 | -1.5 | -2 | -2 | Includes "eat breakfast" and "break down camp" |
| Last day credits | 0 | 0 | 0 | 0 | See "New User Days" below |
| Total | 42.25 | 64 | 79.53571 | 79.53571 | |

Daily Tasks: Hours Used Year-round

| | | | | |
|-----------------------|-----|-----|-----|-----|
| Load boats | 1 | 1 | 1 | 1 |
| Unload boats | 0.5 | 0.5 | 0.5 | 0.5 |
| Eat Breakfast | 0.5 | 0.5 | 0.5 | 0.5 |
| Eat Lunch | 1 | 1 | 1 | 1 |
| Set up camp & eat din | 1.5 | 1.5 | 2 | 2 |
| Break down camp | 1 | 1 | 1.5 | 1.5 |
| Hygiene | 0.5 | 0.5 | 0.5 | 0.5 |
| Total | 6 | 6 | 7 | 7 |

Monthly Variables

A. Eating after Sunset

UDT is based on daylight hours. During winter months, dinner is often eaten in the dark, and should not reduce UDT. The hours spent eating after sunset can be changed by trip type (red numbers)

| | | | |
|------|------|------|------|
| 0.75 | 0.75 | 0.75 | 0.75 |
|------|------|------|------|

The months in which dinner is eaten in the dark can be assigned in Column A below (red Yes or No)

B. Other Monthly Subtractions

Explain monthly subtraction from UDT Daily tasks here and enter time as decimal fractions of an hour by trip type below:

| | | | |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
|---|---|---|---|

The months in which this subtraction applies can be assigned in Column B below (red Yes or No)

C. Monthly Additions

Explain monthly addition to UDT Daily tasks here and enter time as decimal fractions of an hour by trip type below:

| | | | |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
|---|---|---|---|

The months in which this addition applies can be assigned in Column C below (red Yes or No)

TOTAL MONTHLY ADJUSTMENTS TO DAILY TASKS

| Month | A. Dark Dining? | B. Other Subtract | C. Other Add |
|-------|-----------------|-------------------|--------------|
| Jan | Y | N | N |
| Feb | Y | N | N |
| Mar | N | N | N |
| Apr | N | N | N |
| May | N | N | N |
| Jun | N | N | N |
| Jul | N | N | N |
| Aug | N | N | N |
| Sep | N | N | N |

| | | | |
|-----|---|---|---|
| Oct | N | N | N |
| Nov | Y | N | N |
| Dec | Y | N | N |

Final Time Consumed by Daily Tasks by Month (summary only, no user entries needed)

| Month | Commercial | | Private | |
|-------|------------|-----------|---------|-------|
| | Motor | Non-motor | Regular | Small |
| 1 | 5.25 | 5.25 | 6.25 | 6.25 |
| 2 | 5.25 | 5.25 | 6.25 | 6.25 |
| 3 | 6.00 | 6.00 | 7.00 | 7.00 |
| 4 | 6.00 | 6.00 | 7.00 | 7.00 |
| 5 | 6.00 | 6.00 | 7.00 | 7.00 |
| 6 | 6.00 | 6.00 | 7.00 | 7.00 |
| 7 | 6.00 | 6.00 | 7.00 | 7.00 |
| 8 | 6.00 | 6.00 | 7.00 | 7.00 |
| 9 | 6.00 | 6.00 | 7.00 | 7.00 |
| 10 | 6.00 | 6.00 | 7.00 | 7.00 |
| 11 | 5.25 | 5.25 | 6.25 | 6.25 |
| 12 | 5.25 | 5.25 | 6.25 | 6.25 |

New User Days

The last day of a River Trip is assumed to be consumed by take-out, with no UDT. This assumption does create "double dipping" into UDT for River running. Since most trips camp close to the take-out, double dipping is assumed to be minimal. New user days are calculated for each of the four trip types as follows:

existing data sets are in lower case, NEW VARIABLE ARE IN UPPER CASE

| | | | | |
|---|---|---|---|-----------------|
| 1 | probable launches * avg passengers/launch | | | USERS |
| 2 | probable user days / USERS = | | | TRIP LENGTH |
| 3 | TRIP LENGTH - | 1 | = | NEW TRIP LENGTH |
| 4 | NEW TRIP LENGTH * USERS = | | | NEW USER DAYS |

Note that by changing the number subtracted from trip length (shown in red above), new user days will "ripple through" the UDT calculations

Select Light Period

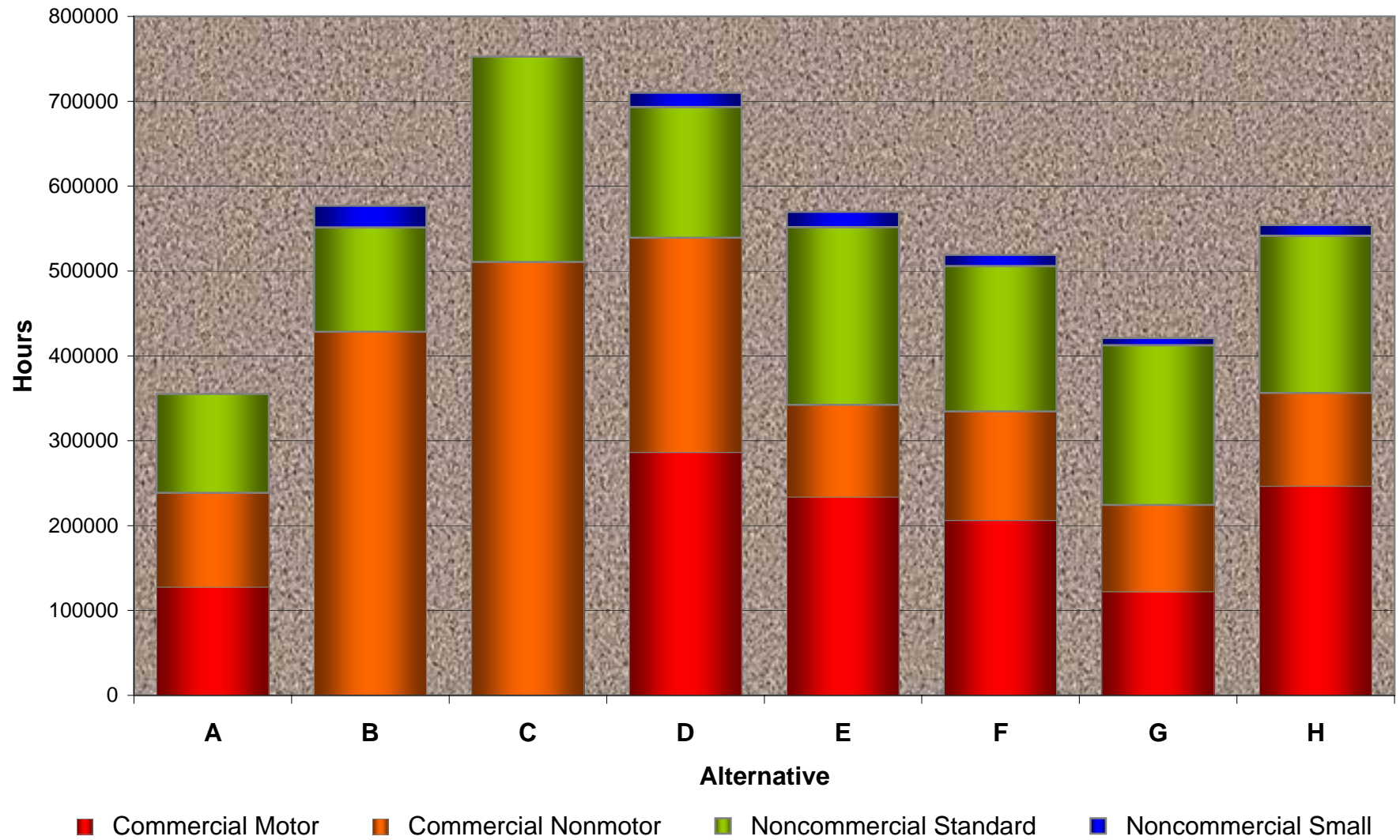
The amount of light available in a 24-hour period forms the basis of the UDT calculation. The available types are listed and defined below. Select the type you would like to use.

- Sunrise and sunset** conventionally refer to the times when the upper edge of the disk of the Sun is on the horizon, considered unobstructed relative to the location of interest. Atmospheric conditions are assumed to be average, and the location is in a level region on the Earth's surface.
- Civil twilight** is defined to begin in the morning, and to end in the evening when the center of the Sun is geometrically 6 degrees below the horizon. This is the limit at which twilight illumination is sufficient, under good weather conditions, for terrestrial objects to be clearly distinguished; at the beginning of morning civil twilight, or end of evening civil twilight, the horizon is clearly defined and the brightest stars are visible under good atmospheric conditions in the absence of moonlight or other illumination. In the morning before the beginning of civil twilight and in the evening after the end of civil twilight, artificial illumination is normally required to carry on ordinary outdoor activities. Complete darkness, however, ends sometime prior to the beginning of morning civil twilight and begins sometime after the
- Nautical twilight** is defined to begin in the morning, and to end in the evening, when the center of the sun is geometrically 12 degrees below the horizon. At the beginning or end of nautical twilight, under good atmospheric conditions and in the absence of other illumination, general outlines of ground objects may be distinguishable, but detailed outdoor operations are not possible, and the horizon is indistinct.
- Astronomical twilight** is defined to begin in the morning, and to end in the evening when the center of the Sun is geometrically 18 degrees below the horizon. Before the beginning of astronomical twilight in the morning and after the end of astronomical twilight in the evening the Sun does not contribute to sky illumination; for a considerable interval after the beginning of morning twilight and before the end of evening twilight, sky illumination is so faint that it is practically imperceptible.

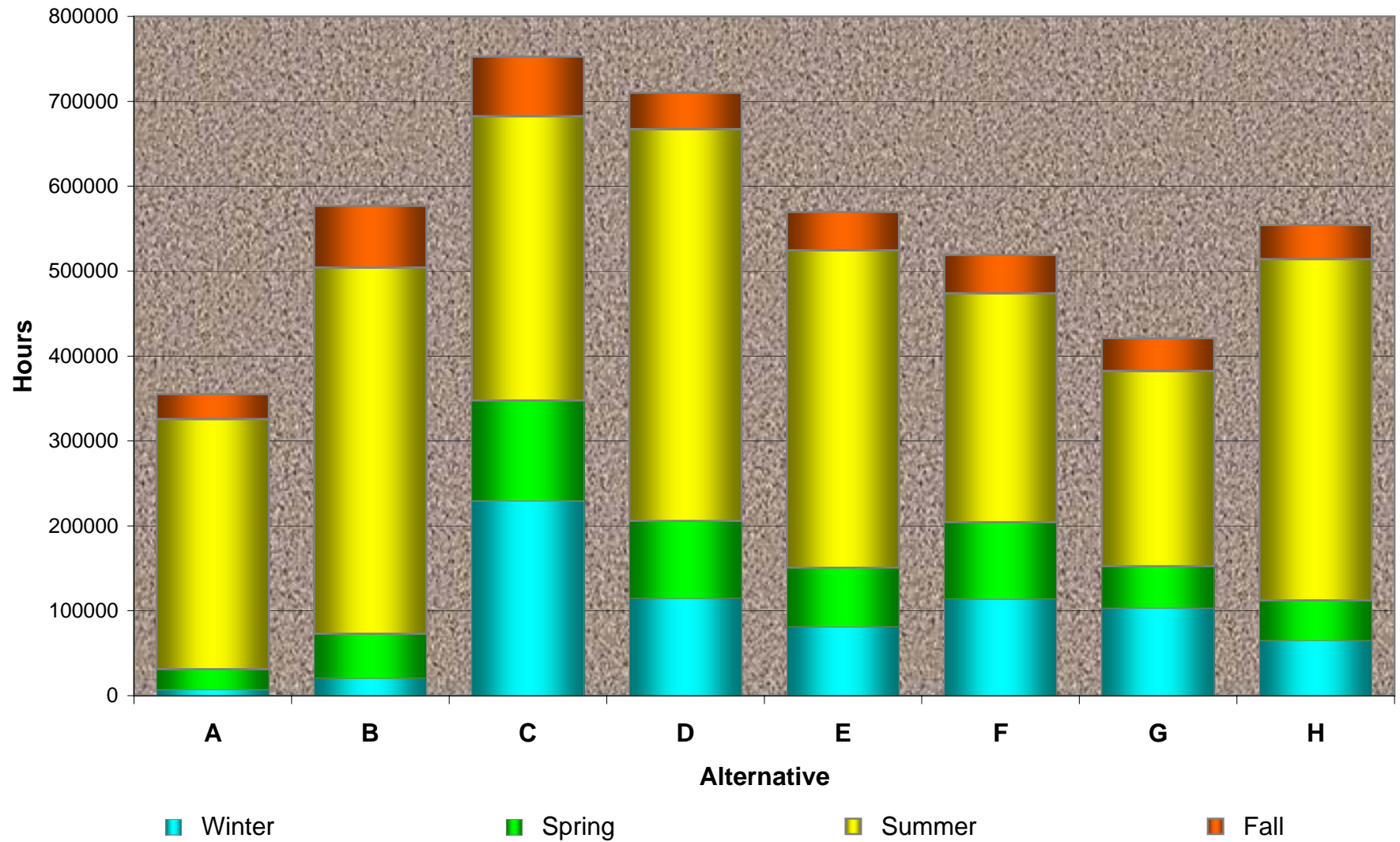
Select the type of daylight you would like to use: 2

You have chosen: **CIVIL TWILIGHT**

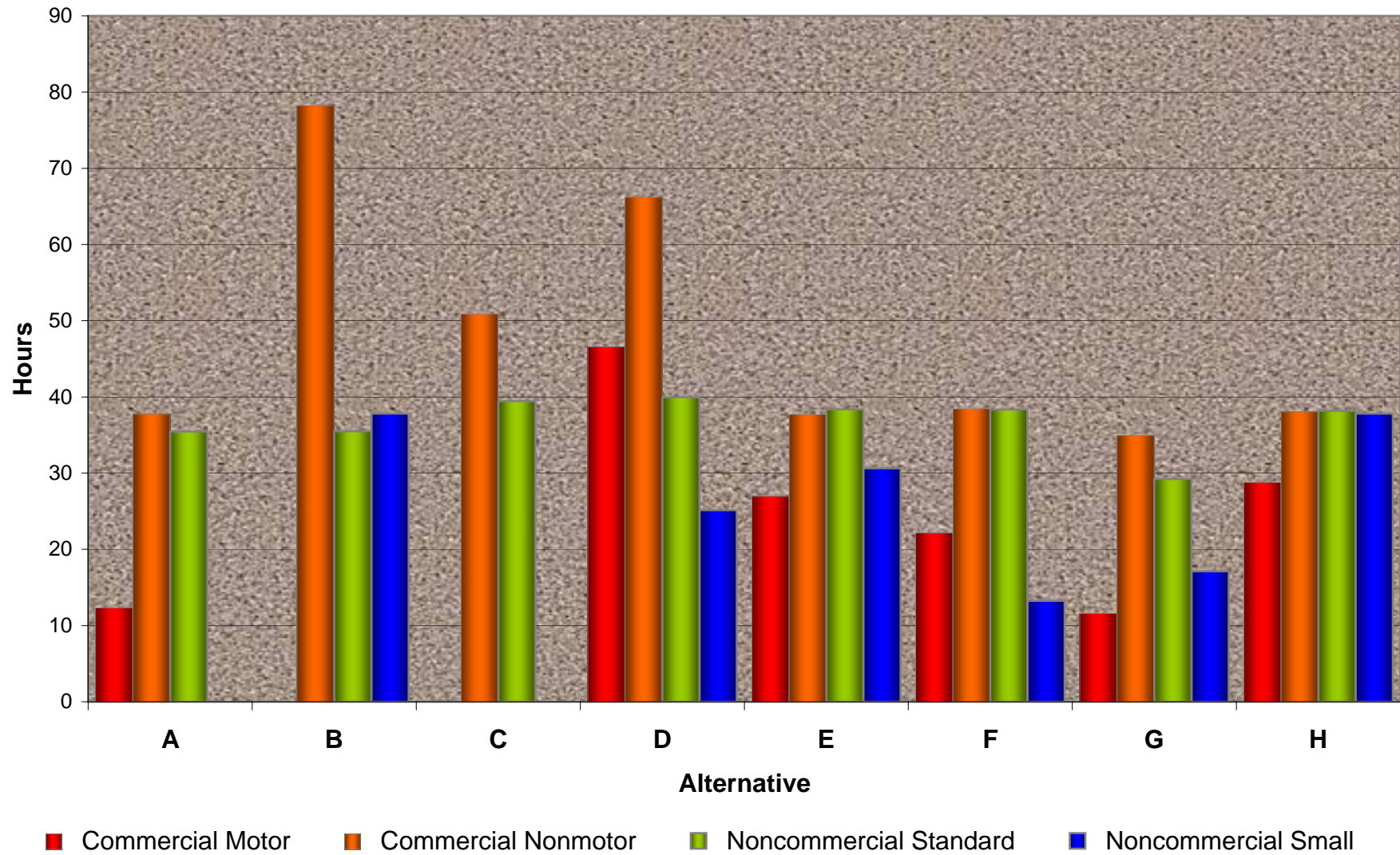
Total User Discretionary Time by Trip Type



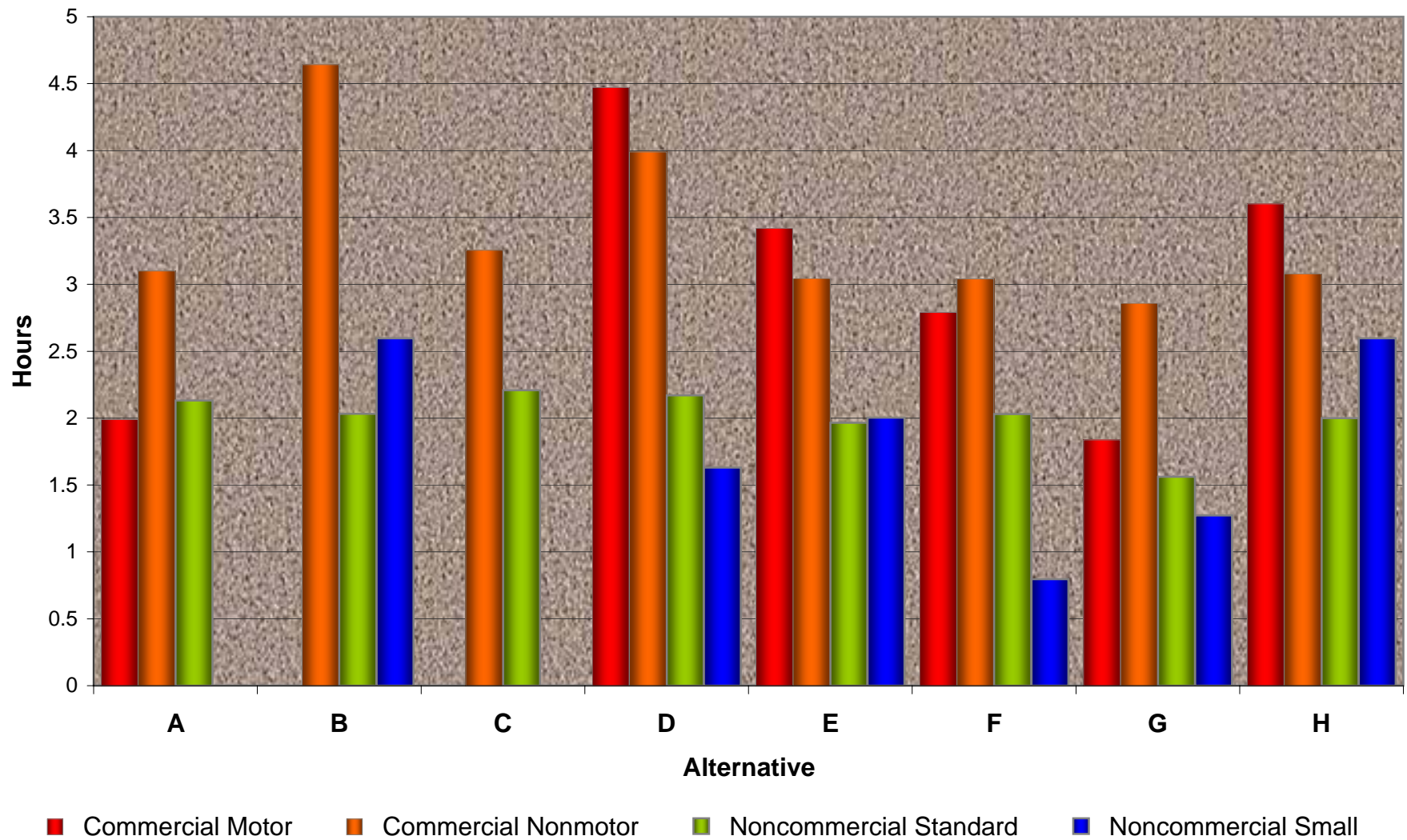
Total User Discretionary Time by Season



Average User Discretionary Time per Passenger



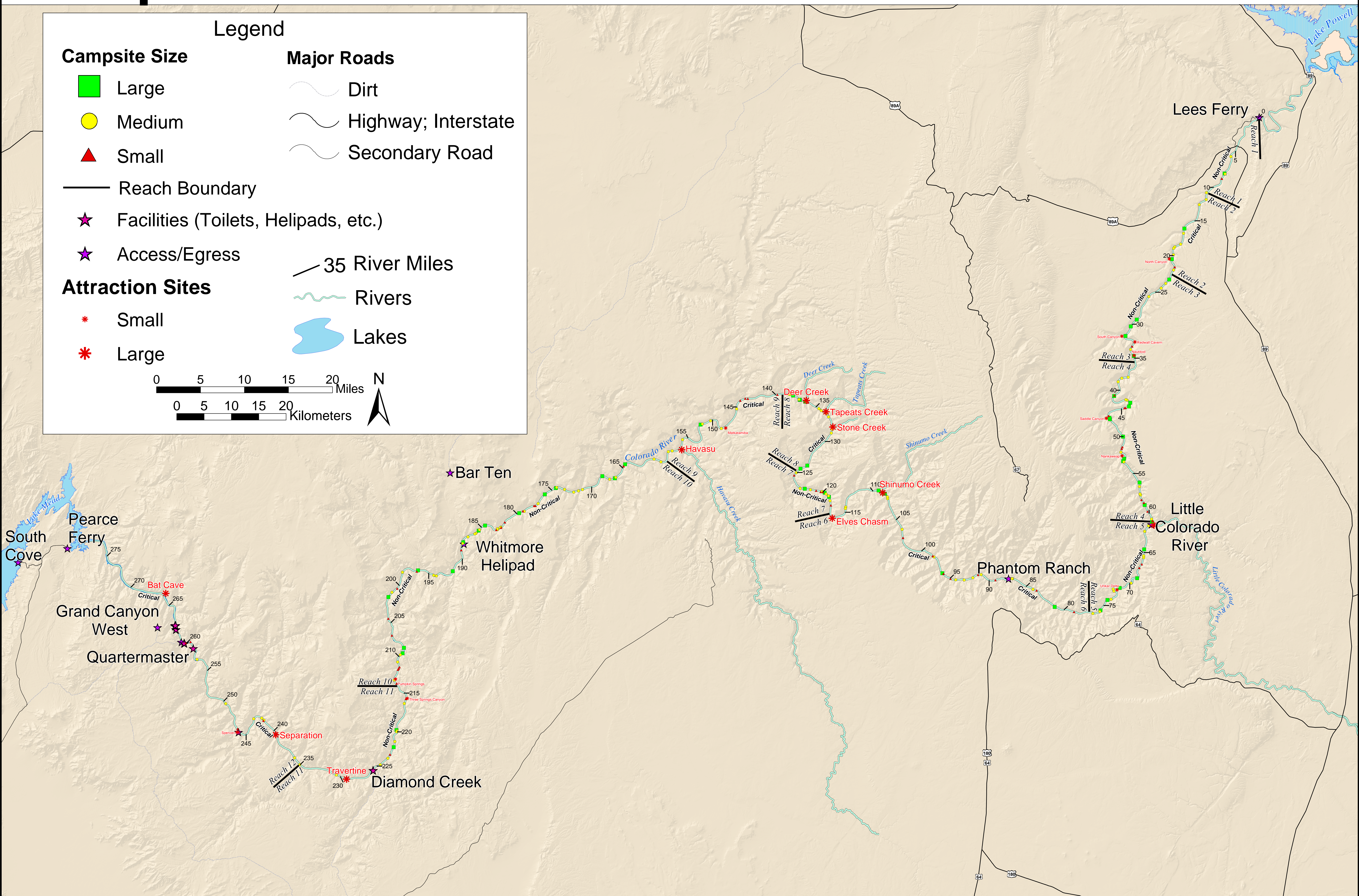
Average User Discretionary Time per Day



APPENDIX I: CAMPSITE DISTRIBUTION



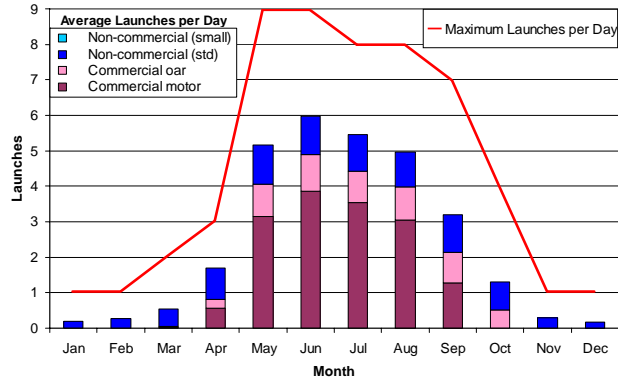
Campsite Size Distribution



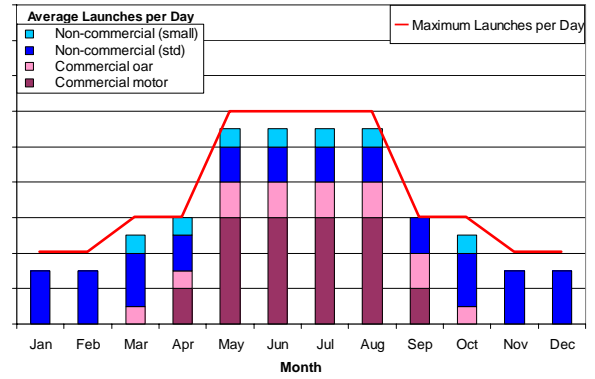
APPENDIX J: COMPARISON OF LEES FERRY ALTERNATIVES

Lees Ferry Alternatives

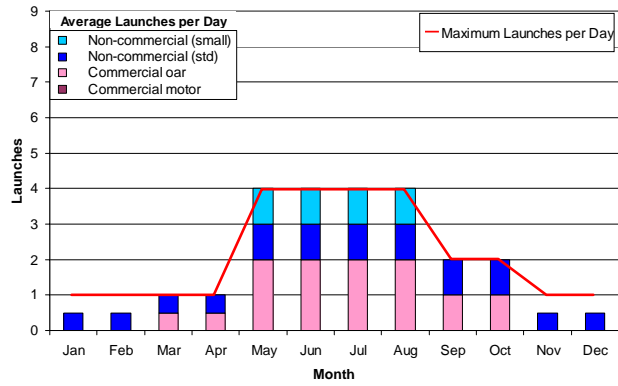
A



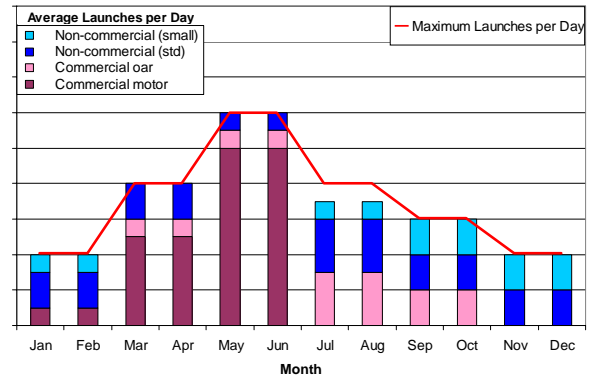
E



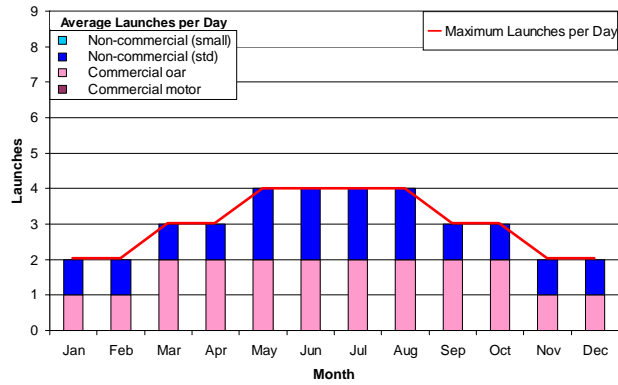
B



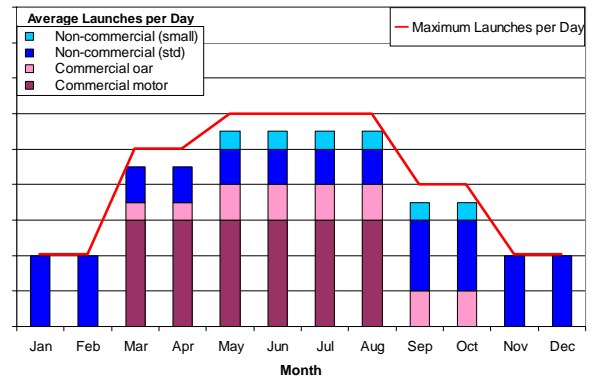
F



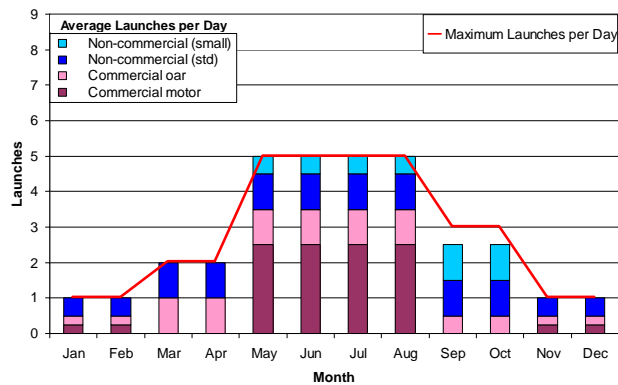
C



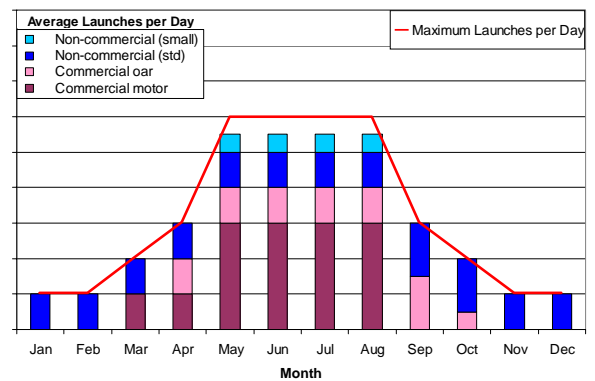
G



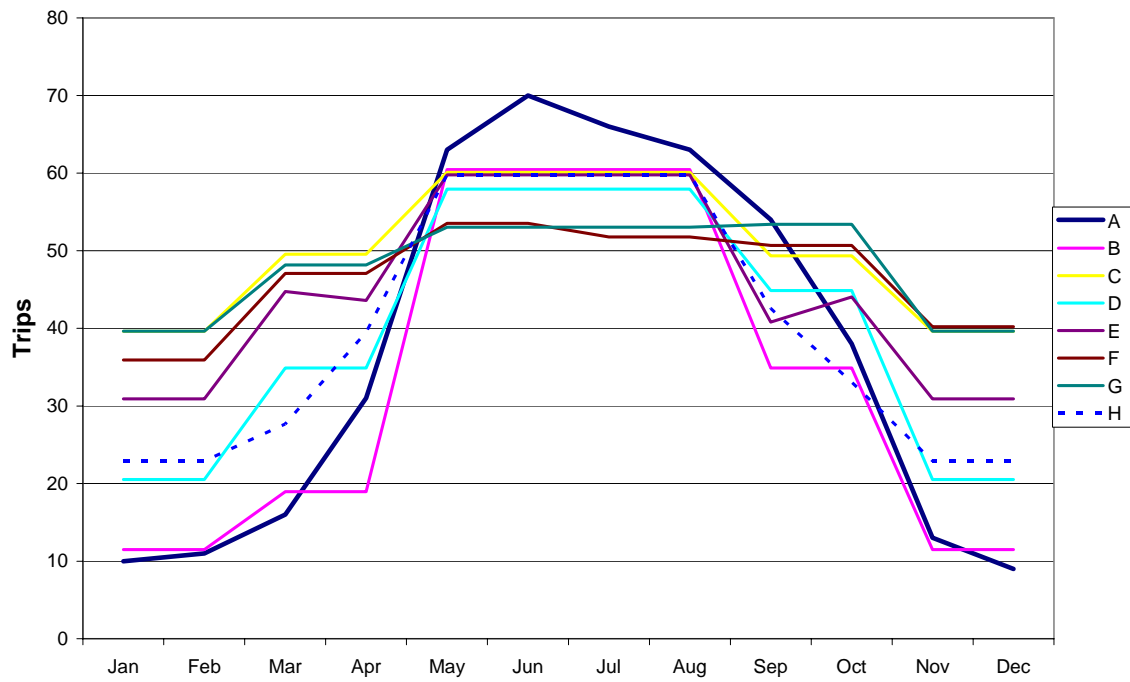
D



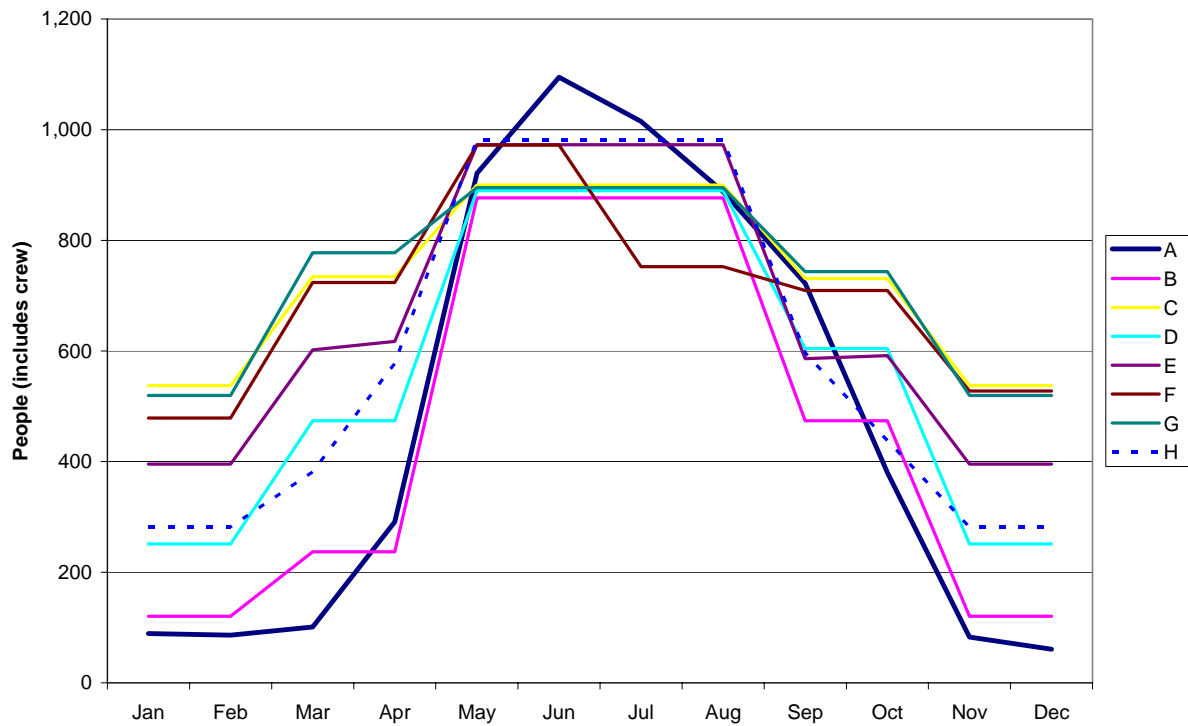
H



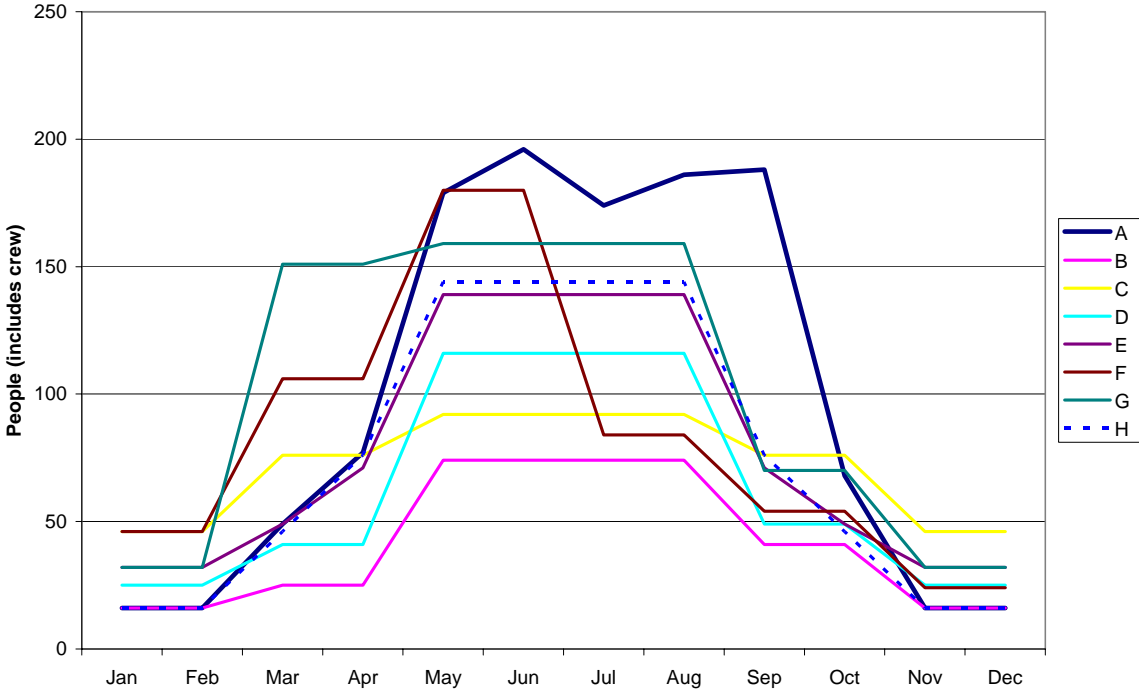
Probable Maximum Trips at One Time (TAOT)



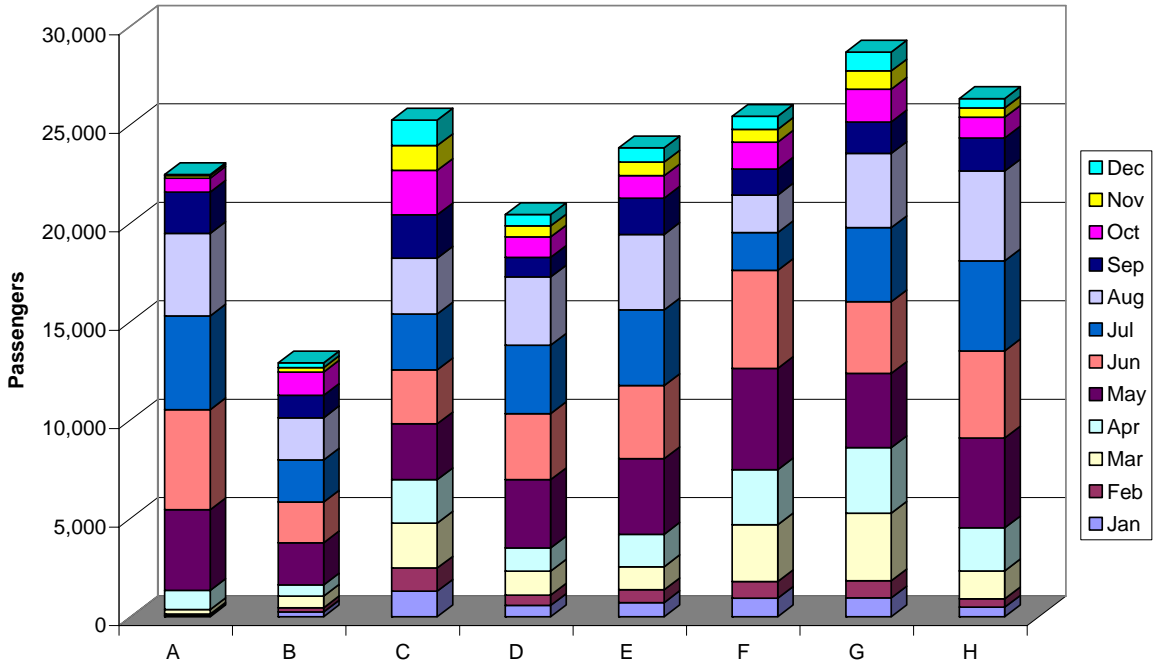
Probable People At One Time



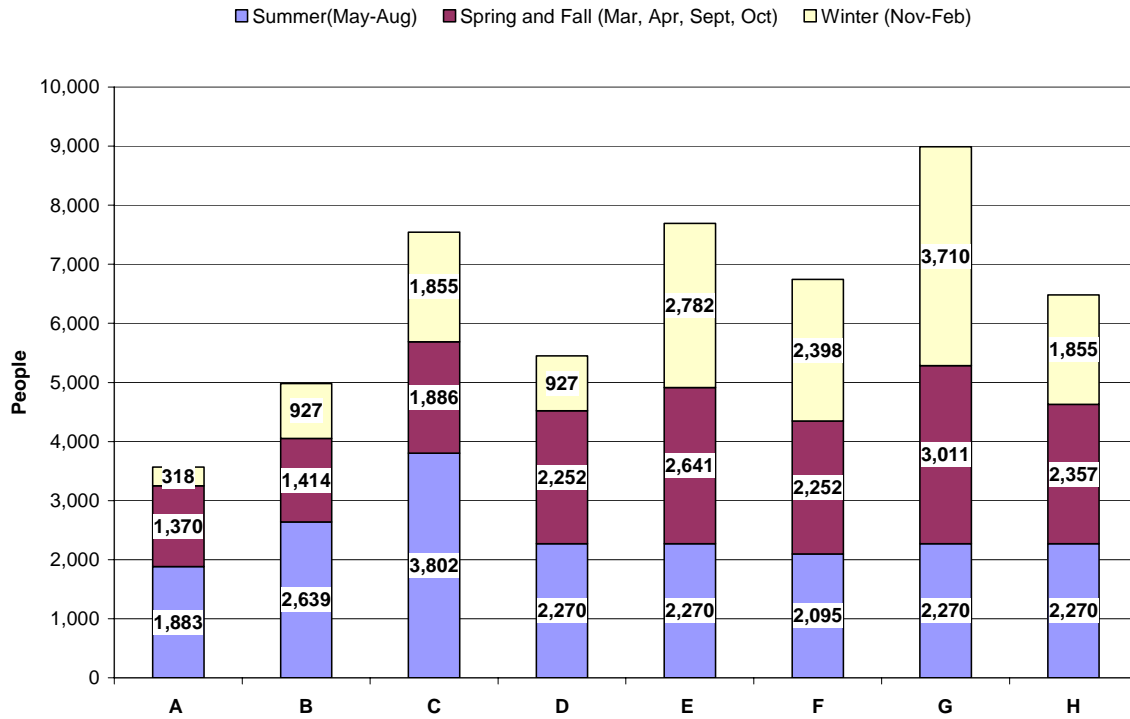
Maximum People Launching on Any Day



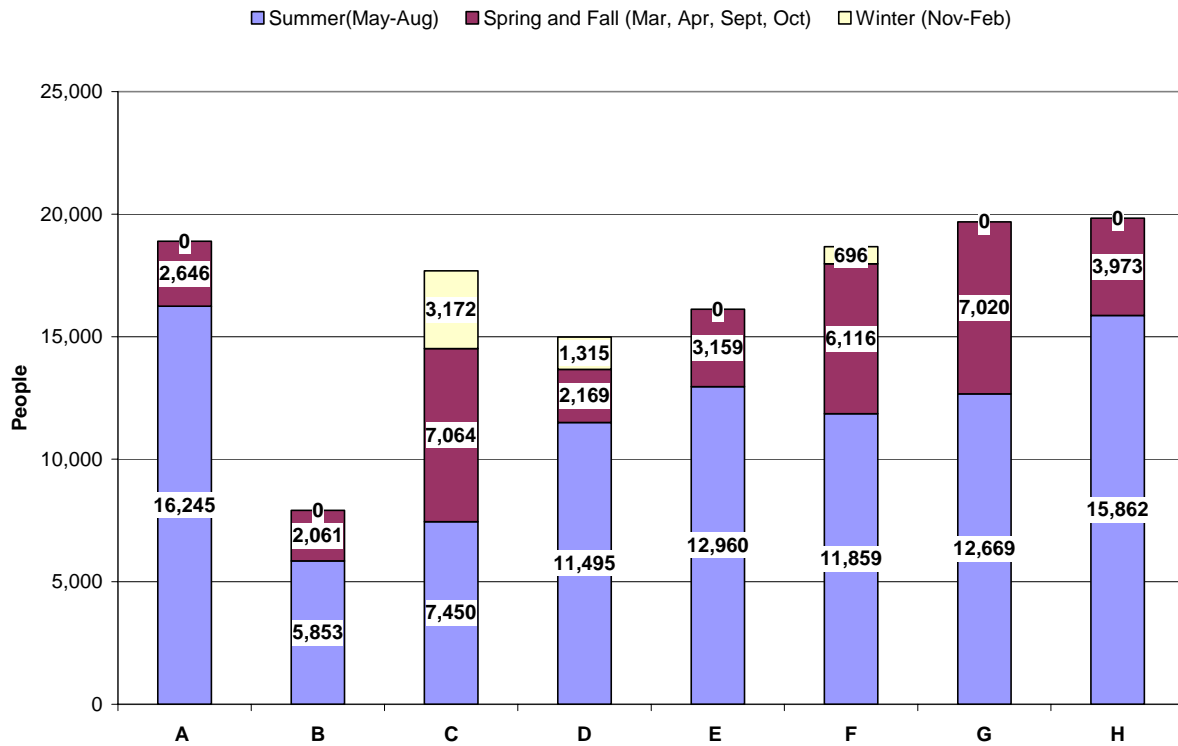
Probable Passenger Totals



Probable Noncommercial Passengers



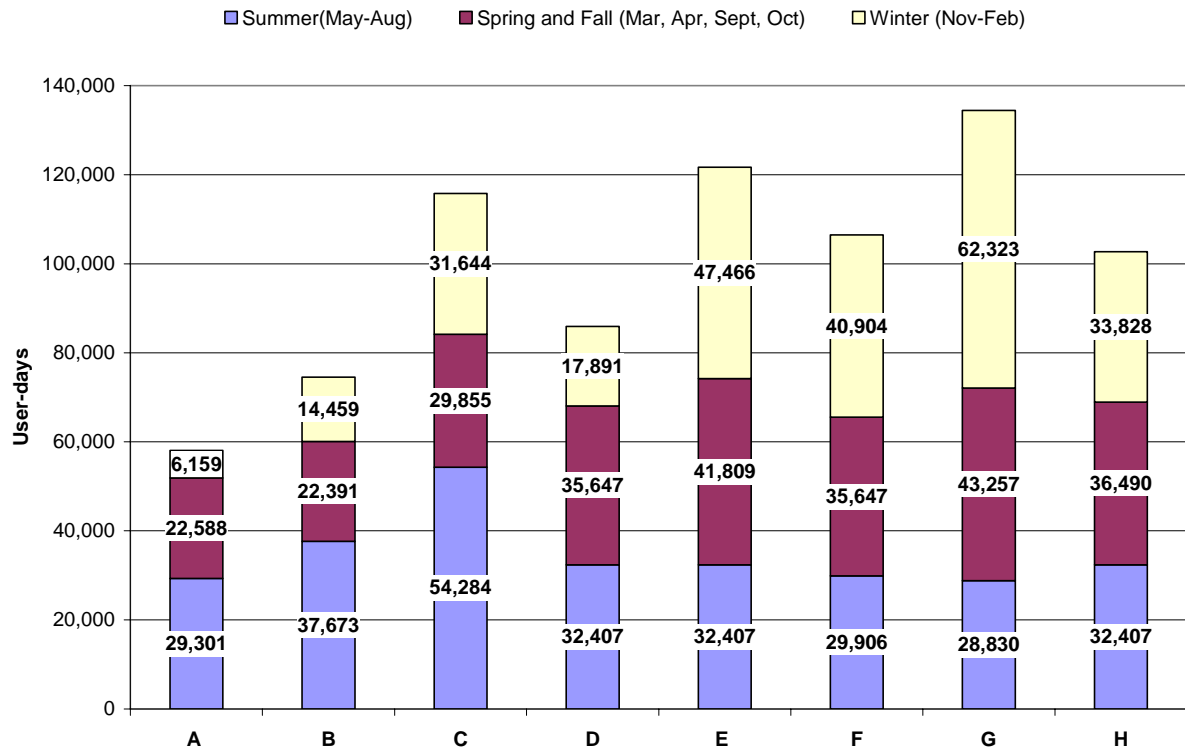
Probable Commercial Passengers



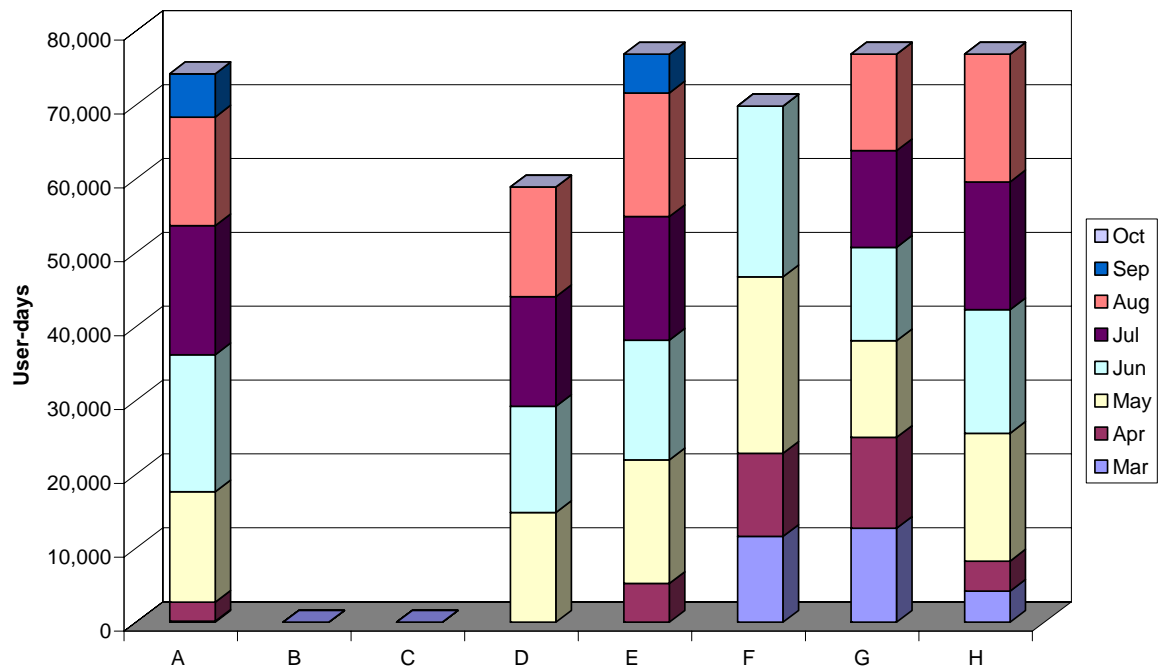
Commercial / Noncommercial Split of Allocation

| | A | B | C | D | E | F | G | H |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| January - February | | | | | | | | |
| Probable Launches | 0 / 100 | 0 / 100 | 50 / 50 | 50 / 50 | 0 / 100 | 25 / 75 | 0 / 100 | 0 / 100 |
| Probable User-days | 0 / 100 | 0 / 100 | 62 / 38 | 55 / 45 | 0 / 100 | 42 / 58 | 0 / 100 | 0 / 100 |
| Probable Passengers | 0 / 100 | 0 / 100 | 63 / 37 | 59 / 41 | 0 / 100 | 39 / 61 | 0 / 100 | 0 / 100 |
| March - April | | | | | | | | |
| Probable Launches | 39 / 61 | 50 / 50 | 67 / 33 | 50 / 50 | 36 / 64 | 75 / 25 | 78 / 22 | 58 / 42 |
| Probable User-days | 32 / 68 | 56 / 44 | 67 / 33 | 53 / 47 | 35 / 65 | 66 / 34 | 69 / 31 | 47 / 53 |
| Probable Passengers | 52 / 48 | 59 / 41 | 79 / 21 | 61 / 39 | 52 / 48 | 83 / 17 | 86 / 14 | 74 / 26 |
| May - August | | | | | | | | |
| Probable Launches | 81 / 19 | 50 / 50 | 50 / 50 | 70 / 30 | 72 / 28 | 73 / 27 | 69 / 31 | 72 / 28 |
| Probable User-days | 76 / 24 | 65 / 35 | 51 / 49 | 74 / 26 | 73 / 27 | 71 / 29 | 72 / 28 | 74 / 26 |
| Probable Passengers | 90 / 10 | 69 / 31 | 66 / 34 | 84 / 16 | 85 / 15 | 85 / 15 | 85 / 15 | 87 / 13 |
| September-October | | | | | | | | |
| Probable Launches | 59 / 41 | 50 / 50 | 67 / 33 | 20 / 80 | 44 / 56 | 31 / 69 | 24 / 76 | 30 / 70 |
| Probable User-days | 55 / 45 | 56 / 44 | 67 / 33 | 29 / 71 | 42 / 58 | 39 / 61 | 28 / 72 | 31 / 69 |
| Probable Passengers | 72 / 28 | 59 / 41 | 79 / 21 | 36 / 64 | 57 / 43 | 51 / 49 | 37 / 63 | 48 / 52 |
| November - December | | | | | | | | |
| Probable Launches | 0 / 100 | 0 / 100 | 50 / 50 | 50 / 50 | 0 / 100 | 0 / 100 | 0 / 100 | 0 / 100 |
| Probable User-days | 0 / 100 | 0 / 100 | 62 / 38 | 55 / 45 | 0 / 100 | 0 / 100 | 0 / 100 | 0 / 100 |
| Probable Passengers | 0 / 100 | 0 / 100 | 63 / 37 | 59 / 41 | 0 / 100 | 0 / 100 | 0 / 100 | 0 / 100 |
| March - October | | | | | | | | |
| Probable Launches | 74 / 26 | 50 / 50 | 57 / 43 | 59 / 41 | 61 / 39 | 66 / 34 | 63 / 37 | 64 / 36 |
| Probable User-days | 69 / 31 | 62 / 38 | 58 / 42 | 63 / 37 | 61 / 39 | 64 / 36 | 62 / 38 | 63 / 37 |
| Probable Passengers | 85 / 15 | 66 / 34 | 72 / 28 | 75 / 25 | 77 / 23 | 81 / 19 | 79 / 21 | 81 / 19 |
| April - October | | | | | | | | |
| Probable Launches | 75 / 25 | 50 / 50 | 56 / 44 | 59 / 41 | 65 / 35 | 65 / 35 | 61 / 39 | 65 / 35 |
| Probable User-days | 70 / 30 | 62 / 38 | 57 / 43 | 64 / 36 | 65 / 35 | 63 / 37 | 60 / 40 | 64 / 36 |
| Probable Passengers | 86 / 14 | 66 / 34 | 71 / 29 | 76 / 24 | 79 / 21 | 80 / 20 | 78 / 22 | 82 / 18 |
| All Year | | | | | | | | |
| Probable Launches | 72 / 28 | 46 / 54 | 55 / 45 | 58 / 42 | 52 / 48 | 55 / 45 | 52 / 48 | 57 / 43 |
| Probable User-days | 66 / 34 | 57 / 43 | 59 / 41 | 62 / 38 | 49 / 51 | 55 / 45 | 46 / 54 | 53 / 47 |
| Probable Passengers | 84 / 16 | 61 / 39 | 70 / 30 | 73 / 27 | 68 / 32 | 73 / 27 | 69 / 31 | 75 / 25 |

Probable Noncommercial User-Day Use



Commercial Motor Use, March - October



Commercial Oar Use, March - October

